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Resource Report

Two Eagle Vegetation Management

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Union County, Oregon

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Introduction

This report analyzes the effects on fisheries and watershed resources for the proposed 7,206 acres Two Eagle Vegetation Management Project (herein referred to as Two Eagle). The description of watershed and fisheries resources, along with the analysis of the expected and potential effects for each alternative were assessed using field surveys, information from water quality databases, supporting literature, and professional judgement.

The following laws, regulations, and management directives for fish, aquatic and watershed resources apply to this project:

- Wallowa-Whitman Land and Resource Management Plan (USDA 1990),
- Interim Strategies for Managing Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada Inland Native Fish Strategy (INFISH USDA 1995) amendment to LRMP. INFISH provides management direction in the form of Riparian Management Objectives (RMOs), Riparian Habitat Conservation Areas (RHCAs) and standards and guidelines for management activities.
- LRMP Biological Opinion (1998)
- Eagle Creek is a Wild and Scenic River and is managed under the Eagle Creek Wild and Scenic River Management Plan (1994). River segments within the Two Eagle Area are designated Recreational and Scenic.
- The National Forest Management Act (NFMA) (1976) requires that the Forest Service manage for a diversity of fish habitat to support viable fish populations. Regulations of NFMA (219.12g) state "Fish and wildlife habitat will be managed…to maintain and improve habitat of management indicator species."
- Section 7 of the 1973 Endangered Species Act (ESA) includes direction that Federal agencies will not authorize, fund, or conduct actions that are likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction of adverse modifications of their critical habitat.
    - Note: There are no ESA-listed fish or aquatic invertebrates present in the project area. However, critical habitat for bull trout is present.
- The Clean Water Act (CWA), also known as the Federal Water Pollution Control Act, represent landmark legislation for protecting water resources. Section 208 of the 1972 amendments to the Federal Water Pollution Control Act (Public Law 92-500) specifically mandated identification and control of non-point source pollution. The CWA delegates certain authorities to individual states. CWA Section (303(d) listed streams), and develop Total Maximum Daily Loads (TDMLs) and Water Quality Management Plans (WQMP) to control the non-point source pollutants causing loss of beneficial uses. A beneficial use of water refers to the specific criteria required to support a specific use of water. For example, cold-water fisheries require cool or cold water temperatures and low turbidity.
    - Section 313 of the CWA requires federal agency compliance with water pollution control mandates that apply to "any nongovernmental entity" or private person. Federal actions shall comply with "all Federal, State, interstate, and local requirements, administrative authority, and process and sanctions respecting the control and abatement of water pollution." A Memorandum of Understanding (MOU) with ODEQ is developed to comply with State Water Quality Standards. The MOU outlines responsibilities for both the Forest Service and ODEQ. The Forest Service agrees to apply all reasonable land, soil, and water conservation practices, often referred to as Best Management

Practices (BMPs). These "performance standards" are designed to protect and maintain soil and water resources, thus maintaining beneficial uses.

- Put in here if there are any streams ODEQ 303(d) listed as water quality limited in the Two Eagle Project area.

- Forest Service Policy: Policy for protection and improvement of soil and water resources include: The National Non-point Source Policy (December 12, 1984); the Forest Service Non-point Strategy (January 29, 1985); and the USDA Non-point Source Water Quality Policy (December 5, 1986). Soil and water conservation practices were recognized as the primary control mechanisms for non-point sources of pollution on national Forest System lands. This perspective is supported by the Environmental Protection Agency (EPA) in their guidance, "Nonpoint Source Controls and Water Quality Standards" (August 19, 1987). Policy is further defined by Forest Service Manual (FSM) direction. FSM sections 2532.02 and 2532.03 describe the objectives and policies relevant to protection and improvement of water quality on National Forest System Lands to maintain designated beneficial uses. Guidelines for data collection activities (inventory and monitoring) are also described (USDA, 1990).
- Executive Order 11988 (Floodplain Management) requires that agencies avoid, to the extent possible, adverse impacts associated with occupancy and modification of floodplains. It applies at a minimum to areas within the 100-year floodplain (Executive Order 1977).
- Executive Order 11990 (Wetlands) states that agencies shall minimize destruction, loss, or degradation of wetlands and shall preserve and enhance their natural and beneficial values. Agencies are to avoid construction in wetlands unless it is determined that there is no practicable alternative and that all practicable measures are taken to minimize harm to wetlands (Executive Order 1977).

Four Alternatives are analyzed in this project: Alternative 1 (no action) and action alternatives Alternative 2 (proposed action), Alternative 2 modified, and Alternative 3.

Project Description

See the EA for a full description of purpose and need, and alternatives for the Two Eagle Vegetation Management Project.

Need for Action

The existing condition across the project area consists of forest stands and vegetation that deviate from the historic (natural) range of variability (HRV). This project will help restore the full range of vegetative patterns within the HRV across the landscape. The following are specific components of the desired condition across this landscape.

- Forest composition dominated by ponderosa pine and western larch across much of the landscape and all species in balance with natural disturbance regimes and site potential growth.
- Live and dead fuel loads within acceptable ranges of the natural scale and intensity of wildfire for the site.
- Insects and diseases occurrences mostly at endemic levels. Fluctuation occurs during normal outbreak cycles.
- Mistletoe infection levels within natural ranges of a fire maintained landscape. Mistletoe infections would exist at an endemic level without threatening the development and maintenance of late and old structure forest (LOS).

- Structural stages within HRVs for its respective biophysical environment. Increase single story structure especially in warm dry forest environments.
- Forest stand tree densities within ranges of natural disturbance regimes, site potential, and development of future LOS.

Description of Alternatives

The Forest Service has developed three alternatives and one modified alternative for the Two Eagle Project EA: Alternative 1 (No Action), Alternative 2 (Proposed Action), Alternative 2 modified, and Alternative 3, generated in response to issues raised by the public during scoping. The action alternatives are summarized in Table 1 and described in depth in the Alternative Description section of the EA.

Table 1. Summary of Two Eagle Alternatives

Alternative Elements		Alt 1	Alt 2	Alt 2M	Alt 3
Project Area Boundary (PAB) Acres			7,206 Acres		
Subwatersheds:					
Bennet Creek-Eagle Creek			2,090 Acres		
Upper Eagle Creek			967 Acres		
West Eagle Creek			3,872 Acres		
WUI Acres:					
Eagle Creek/Tamarack CG WUI (in Project Area)			2,554 Acres		
Total Eagle Creek/Tamarack CG WUI Acres			7,808 Acres		
Total Harvest/Noncommercial Treatment Acres		**0**	**2,533**	**2,576**	**2,072**
Harvest Treatment Acres (total)		**0**	**1,507**	**1,869**	**1,167**
Total Acres Treated by Prescription Type (Commercial)	HIM	0	1,116	1,116	818
	HTH	0	348	348	313
	HPO	0	35	35	35
	RHC-HPO	0	7	7	0
	HCR	0	1	1	1
	WFM	0	0	362	0
Noncommercial Treatments		**0**	**1,026**	**707**	**905**
Total Acres Treated by Prescription Type (Noncommercial)	RWF	0	642	390	635
	PCT	0	384	290	270
	Meadow	0	0	27	0
Post-Treatment Activities		**0**	**3,420**	**3,281**	**2547**
Post-Harvest Treatment Activities (Acres)	Whipfell	0	1,507	1,550	1159
	Grapple Pile	0	1,570	1,477	1253
	Hand Pile	0	249	162	135
	Plant	0	92	92	92
Prescribed Fire (Acres)	Total	**0**	**6,519**	**6,369**	**5,340**
	Jackpot / Underburn	0	985	928	995
	Natural Fuels Burn Blocks	0	3872	3872	2957
	Pile Burn	0	1,662	1,569	1,388

Treatments within RHCAs (Acres)	Commercial Harvest Treatments	0	2	2	1
	Non-Commercial Harvest Treatment	0	6	33	0
Yarding Systems (Acres)	Tractor/WTY	0	1,209	1,209	1,014
	Skyline/LTA	0	291	291	198
Road Work (Miles)	Reconstruction	0	1.7	1.7	0.7
	Temporary Roads - Total • Miles on Existing • Miles of New	0	5.25 1.75/3.5	5.25 1.75/3.5	3.57 1.12/2.45
	Miles of Closed Roads Opened (Maintenance)	0	15.33	15.33	8.42
	Decomissioning	0	11.06	11.06	11.06
	Culverts: Temp/Permanent	0	4/3	4/3	3/3
Enhancement/Safety Work	Watershed Enhancement	0	0	0	0
	Danger Tree Removal	No	Roadside	Roadside	Roadside
	Cottonwood Restoration (Acres)	0	8	8	1
Harvest Volume in million board feet (MMBF)	Sawtimber Volume	0	5.8	5.8	4.6
	Non-Saw Volume	0	1.2	1.2	1.0
	Total Volume (MMBF)	0	7.0	7.0	5.6
Old Forest Treatment Acres	OFMS Restored to OFSS	0	394	394	384
Eagle Creek WSR Acres	Commercial Harvest • Total • Recreation Section • Scenic Section	0	 387	 387	311
	Non-Commercial Treatment • Total • Recreation Section • Scenic Section	0	 86	 113	162

	Prescribed Burning • Total • Recreation Section • Scenic Section	0	153	267	267
Project Area PVG Acres	Moist Upland Forest	3,317			
	Dry Upland Forest	1,872			
	Cold Upland Forest	1,047			
	Total Forested Acres	6,236			
	Total Non-forested Acres	970			
FPlan Management Area Acres	MA1	5,528			
	MA15	512			
	MA7	1,104			
	MA15-7	62			

Proposed Timber Harvest and Prescribed Fire Activities in Riparian Habitat Conservation Areas (RHCAs)

In Alternative 2, and 2 modified (2m), 8 acres total of non-commercial and commercial thinning would occur in RHCAs. Two acres of commercial harvest within these 8 acres would occur in RHCAs. A small amount of commercial harvest in RHCAs in 4 units; unit 84, 95, 112, and 113, would occur, where tree removal can occur from the road prism (off of the 77 road for units 95, 112 and 113, and off of the 7755 and an existing temporary road for unit 84). Total commercial harvest area is 2 acres, a fraction of the unit acres combined. Equipment would not leave the road prism to harvest trees. Trees would be felled and removed with near total suspension to avoid ground disturbance. Trees that would be harvested are conifer trees that are around cottonwood, western larch, and ponderosa pine for patch opening in units 95, 112 and 113. In unit 84, thinning conifers would occur around a cottonwood stand to enhance the seed tree source. In Alternative 3, RHCA commercial harvest would occur in unit 84 only.

In units 112 and 113, the outer 100 feet of the RHCA buffer of Category 1 West Eagle Creek would be thinned. In unit 95, outer edges of a Category 2 RHCA to the north and a Category 4 RHCA to the south would be entered and have thinning treatment, a no activity buffer of 75 feet for the Category 2 stream and 50 feet for the Category 4 stream would have no activity. In unit 84, the east side of the unit would be thinned from the 7755 road.

No active lighting would take place within RHCAs. Upland prescribed fire units will be ignited as determined in prescribed fire burn plans, down to the outer RHCAs. Within RHCAs fire will be allowed to continue to burn and spread, usually as a backing fire, without further influence from ignition sources. Fire backing into RHCAs would be low intensity fire. Under circumstances where unmanipulated fire activity threatens to exceed a maximum burn prescription parameters and/or control of the burn is threatened, hand ignition would continue into the RHCA as necessary. Instances of hand ignition within RHCA buffers is expected to be rare and typically only occur with unexpected changes in wind direction. For Alternative 2, the outer edges of 772 acres of RHCA could be effected by prescribed fire treatments. There are 475 acres of Category 1 RHCAs, 135 acres of Category 2 RHCAs, and 161 acres of Category 4 RHCAs that could be impacted by prescribed fire. In Alternative 2m there are 785 acres of prescribed fire treatments that could affect the outer edges of RHCAs including 477 acres in Category 1 RHCAs, 144 acres in Category 2 RHCAs, and 164 acres in Category 4 RHCAs. In Alternative 3, the outer edges of 537 acres of RHCA could be effected by prescribed fire treatments, including 292 acres in Category 1 RHCAs, 128 acres in Category 2 RHCAs, and 117 acres in Category 4 RHCAs.

Non Commercial harvest in RHCAs

In Alternative 2, and 2m, 8 acres total of non-commercial and commercial harvest would occur in RHCAs. Six of these acres are non-commercial thinning where co-dominant trees and ladder fuels would be removed to create a canopy opening around cottonwood and early seral species of western larch or ponderosa pine. Thinning would be completed by hand treatment only and create canopy openings around cottonwood, western larch and ponderosa pine that are not within reach of the road prism for commercial harvest. Felled trees would be lopped and scattered. This treatment would contribute to ecosystem stability by reducing stand densities around hardwoods and removing fuel loadings and ladder fuels contributing to increased risk of uncharacteristic wildfire intensity and severity within riparian areas (Johnson 1989). See Mule Deer Habitat Enhancement below for an additional 27 acres of thinning activities within the RHCA of Eagle Creek. No non-commercial harvest is proposed in Alternative 3.

Proposed Transportation Systems in RHCAs

No new roads will be constructed in any alternative. In Alternatives 2, 2m and 3, one small segment of one temp road, T-24, has .16 miles within an RHCA. This short segment of T-24 is within the outer edge of Eagle Creek, Category 1, RHCA.

In Alternative 2 and 2m, 1.5 miles of road in RHCAs that are currently closed will be opened for accessing units and hauling purposes and reclosed when the project is completed. Approximately 0.7 miles of these roads are within Category 1 fish bearing RHCA buffers. The longest segment is on the 7700550 road (0.38 miles). Most of these miles in RHCAs are where a road crosses a stream, rather than where a road is parallel to a stream. In Alternative 3, 1.08 miles of road in RHCAs that is currently closed will be opened for hauling purposes and reclosed when the project is completed.

Closing these roads to vehicular traffic after project activities would eliminate incidental sediment delivery to stream channels caused from erosion on forest roads and sediment input where stream channels cross roads or where roads are adjacent to channels in draw bottom areas.

Approximately .4 miles of road reconstruction on open (ML 2) roads would occur within RHCA buffers in Alternative 2 and 2m, and 3. This includes 0.33 miles of reconstruction work on the 7700000 road that is within Category 1 fish bearing stream (Eagle Creek) RHCAs and less than one tenth of a mile in Category 4 RHCA.

Culvert replacements and removals

One culvert on Category 1 stream, Jim Creek, on the 7700462, would be installed. This is a Category 1 fishbearing stream with redband and brook trout, and is less than .25 miles from the West Eagle Creek confluence. The culvert would be temporary, and would follow stipulations in Oregon Fish Passage Policy (ODFW 2017). The ODFW in-water work window guidelines (2008) would be followed; in water work timing window would be July 1 to October 31.

On the 7700520 road a culvert would be installed on a Category 4 tributary to West Eagle Creek. This location is less than .25 miles upstream from the West Eagle confluence.

Two culverts would be installed on the 7700472 and 7700473 roads that are currently closed and would be opened for project activities. These stream crossings are approximately .25 miles upstream from Jim Creek. This tributary to Jim Creek is an ephemeral draw, with no defined channel.

Culverts will be sized appropriately to accommodate 100 year flood event flows. Culverts will be removed after timber sale activities are completed.

Road Decommissioning

Three and a half miles of ML 1, 2, and 3 roads located in RHCAs would be decommissioned in Alternatives 2, 2m, and 3. This includes 2.65 miles in Category 1 RHCAs. The majority of roads being decommissioned (2.66 miles) are roads currently open to high clearance vehicles (ML 2). Decommissioning of these roads would address hydrologic concerns such as restoring natural hillslope runoff patterns and reducing sedimentation by providing additional drainage such as surface cross drains.

The 7700000-535 road would be decommissioned in all alternatives. This would eliminate an open ford crossing over West Eagle Creek. A gate would be placed on this road to eliminate the ford.

Watershed Improvement

Two culverts on the 7700 road on Category 1 Jim Creek and Grove Creek are undersized and block fish passage at certain flows. These two culverts would be replaced with appropriately sized culverts following the Oregon Fish Passage Policy (ODFW 2017). An undersized culvert that impedes fish passage would be pulled on upper Jim Creek on the 7700460 road and the road will be closed (gated).

Mule Deer Habitat Enhancement

In alternative 2m, three meadows along Eagle Creek in the project area have receded in size due to increased growth of lodgepole pine and grand fir. This increase in suitable habitat for conifer growth and therefore decrease in wet meadow vegetation and habitat is likely due to less frequent inundation of the floodplain and overall drier conditions in what were historically wet meadow areas. Another factor could be fire suppression that decreased disturbance regimes through these meadow areas. These meadows provide important habitat for early spring calving for mule deer. Restoration work to decrease encroachment of conifers into meadows has been identified as an opportunity in this project.

All of unit M2, most of unit M3 and about half of the acres in unit M1 are within the Category 1 RHCA of Eagle Creek. The other portions of units M1 and M3 are beyond the 300 feet buffer of Eagle Creek. Minor hand thinning of conifer would occur between 80 feet and 300 feet distance from the edge of the active channel. All cutting would be performed by hand, with the purpose of thinning lodgepole pine and grande fir under 9 inches DBH. Trees greater than 9 inch DBH would be retained in the meadow. No trees within one site potential tree height distance of the stream would be thinned, avoiding any effect of reduction in shade to the stream. Slash from thinning would be bucked up into smaller sections and scattered, piled and burned at a later date or added to existing logjam habitat structures in Eagle Creek for fish habitat enhancement. Mule deer enhancement would occur on 27 acres in units M1, M2, and M3.

Meadow Restoration

Alternatives 2, 2m, and 3 include meadow restoration in the wet meadow behind Two Color Guard Station. This meadow has been accessed and utilized by motorized vehicles as a travel route to access Eagle Creek. The meadow, as well as the riparian area and streambanks of Eagle Creek have received extensive damage from ATV use, and is in need of restoration activities including eliminating motorized activities and laying patches of native sod in the downcut areas running through the meadow to rehabilitate the disturbed ground. To restore and preserve the scenic integrity and species diversity of the meadow, stream banks, and riparian area, an estimated 40-50 feet long section of buck and rail fence would replace the existing primitive barrier behind the guard station parking lot which is currently being navigated around. Foot access to the river would remain in its current condition. Equipment or hand tools would be used to scrape sod from local materials and strategically place sod mats throughout the downcut channel to slow water flows, disperse water, and agrade the channel to naturally back up and store sediment. Only hand tools will be used in the RHCA.

A second wet meadow along the 7755-075 spur road has been damaged by motorized use and would benefit from restoration. Proposed restoration activities include using low ground pressure equipment to scrape sod mats from areas near the decommissioned road and use sod mats to fill the downcut tire ruts going through the meadow. This would slow down water energy and help disperse water back across the meadow as well as enable sediment to fill in behind the sod. The nearby fuels treatments would also aid in the restoration effort by removing conifers that have encroached into the meadow and compete for moisture.

<u>Design Features to Protect Aquatic/Watershed Resources</u>

The following design measures will be implemented to protect aquatic resources. These design features will be incorporated into the alternatives in the EA.

1. Implement applicable INFISH Standards and Guidelines
2. Implement the following project specific design features to minimize impacts to watershed and aquatic resources:
    - Fuels Reduction Activities
        - Use low intensity prescribed fire to reduce fuels loads and reduce the risk of wildfire spread through RHCAs. Limit prescribed fire intensity and spread by using backing fire and not actively lighting in RHCAs.
    - Timber Harvest Activities
        - There would be no mechanical entry into RHCAs where the limited amount of harvest will occur from existing road prisms.
        - Where closed roads are reopened for mechanical thinning activities, re-close roads promptly following completion of the timber sale. Reseed with native grass seed mix as recommended by the district botanist.
        - To minimize increases in soil erosion as a result of timber sale activities: 1) rehabilitate landings after completion of timber harvest activities where needed to minimize bare soil, 2) use BMPs (e.g. scattering slash, seeding, construction of waterbars) to minimize erosion from skidtrails.
        - When designing and constructing temporary roads use BMPs that reduce erosion potential.
        - To prevent an increase in road density in the project area, obliterate temporary roads after completion of haul activities. Where existing road beds are used for temporary roads remove culverts, outslope roadbed, scarify roadbed, scatter slash and seed with native plant mixture recommended by the district botanist.
        - There are no landings in RHCAs
        - Avoid ground-based harvesting systems on slopes >30%.

Project Area

The Two Eagle Vegetation Management Project (hereafter called Two Eagle Project) is located on the Wallowa-Whitman National Forest, La Grande Ranger District, Baker County, Oregon. The project area primarily encompasses three main subwatersheds (Bennet Creek-Eagle Creek, Upper Eagle Creek, and West Eagle Creek). Table 2 below displays subwatershed acres in the project area.

The project area consists of 7,206 acres of NFS (National Forest System) lands. Private land in the southern part of the project area has been removed from the interior of the project area boundary. No treatments are proposed for private or county owned lands.

Table 2. Watershed and subwatersheds in the Two Eagle Project area

Watershed Name/Number	Subwatershed Name/Number	SWS Acres (Total)	FS Acres	Other (Private, State & BLM)	Project Area Acres
Eagle Creek/	Bennet Creek-Eagle Creek/ 170502031003	11,057	10,388	669	2,090

1705020310	Upper Eagle Creek/ 170502031001	15,431	15,431	0	967
	West Eagle Creek/ 170502031002	12,532	12,532	0	3,872

Existing Conditions

The analysis area for watershed processes encompasses portions of three subwatersheds, Bennet Creek-Eagle Creek, West Eagle Creek and Upper Eagle Creek, in the project area.

Forest Plan Aquatic Habitat / Riparian Desired Future Conditions

The WWNF Forest Plan was amended in 1995 with the INFISH Forest Plan Amendment. INFISH (USDA 1995) established goals for aquatic and riparian habitat. The goals of INFISH are to maintain or restore:

- Water quality, to a degree that provides for stable and productive riparian and aquatic ecosystems;
- Stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport) under which the riparian and aquatic ecosystems developed;
- Instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges;
- Natural timing and variability of the water table elevation in meadows and wetlands;
- Diversity and productivity of native and desired non-native plant communities in riparian zones;
- Riparian vegetation to:
    - Provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems;
    - Provide adequate summer and winter thermal regulation within the riparian and aquatic zones; and
    - Help achieve rates of surface erosion, bank erosion, and channel migration characteristic of those which the communities developed.
- Riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geo-climatic region; and
- Habitat to support populations of well-distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian-dependent communities.

Forest Plan Riparian Management Objectives

Effects to riparian and aquatic habitats are minimized by restricting management activities in Riparian Habitat Conservation Areas (RHCAs) (INFISH USDA 1995). RHCA widths for the Two Eagle Project are displayed in Table 3. RHCA boundaries are estimated in GIS for planning and analysis purposes. RHCAs are delineated and marked during sale layout activities.

Table 3. RHCA widths for Two Eagle Project Area.

RHCA Category	Stream / Feature Type	Description
1	Fish Bearing Streams	300 feet slope distance from the edge of the active channel

2	Perennial Nonfish Bearing Streams	150 feet slope distance from the edge of the active channel
3	Ponds, Wetlands (≥1 acre in size)	150 feet slope distance from the edge of the active channel
4	Intermittent Nonfish Bearing Streams, Wetlands (<1 acre in size)	100 feet slope distance from the edge of the active channel
4	Landslides and Landslide-prone Areas	100 feet slope distance from the edge of the landslide or landslide-prone areas

Default INFISH RHCAs and RMOs are used in this analysis. INFISH allows the development of site specific RHCA widths and RMOs were justified by a watershed analysis (INFISH USDA 1995). A watershed analysis was completed for the Eagle Creek system in 1997. The Eagle Creek Watershed Analysis- (USDA 1997) did not recommend changes in RHCAs widths or RMOs. Analyses of INFISH RMOs for pool frequency and width-to-depth ratios compared to watershed conditions were completed but specific changes to the RMOs were not recommended.

There are a total of 19.8 miles of fish-bearing (INFISH Category 1) streams in the analysis area (Table 4). There are no Endangered Species Act (ESA) listed fish species, including bull trout, currently occupying habitat in the project area or analysis area, however Eagle Creek and West Eagle Creek are designated critical habitat (DCH) for bull trout (see Table 4). Eagle Creek and West Eagle Creek are protected under the ESA; 6.0 miles of Eagle Creek and 5.0 miles of West Eagle Creek are within the project area. Eagle Creek and West Eagle Creek are in the Mid-Columbia Recovery Unit Implementation Plan, Powder River Basin (USFWS 2015). These creeks are considered historically occupied core areas (USFWS 2010). According to the recovery plan there is foraging, migrating, and overwintering habitat present in Eagle Creek and West Eagle Creek and they may be considered sites for reintroducing bull trout (USFWS 2002, 2015). Past fish stocking in the Eagle Creek watershed has been extensive (USDA 1997). The introduction of non-native brook trout (*Salvelinus fontinalis*) into the high mountain lakes has impacted native bull trout populations by hybridization (USDA 1998; USFWS 2002). Land management activities have altered stream flows and riparian vegetation, which have negatively affected bull trout (USFWS 2002). Dams, irrigation diversions, and road crossings have further impacted and isolated bull trout populations.

In 2014, 20 sites within the Eagle Creek watershed were sampled using eDNA extraction and analysis (Archuleta 2015). This analysis used species specific primers to detect bull trout and brook trout in Eagle Creek. The analysis of the Eagle Creek water samples occurred at a genetics laboratory at Washington State University in Pullman, Washington using quantitative PCR protocols for each species following the methods of Goldberg et al. (2013). No bull trout were detected at the 20 sites sampled in the Eagle Creek Watershed, including Eagle Creek. Brook trout were detected in Eagle Creek and West Eagle Creek.

Wild rainbow trout/redband trout occupy 19.8 miles of fish bearing streams in the project area. Additionally, the Oregon Department of Fish and Wildlife annually stocks 8 inch hatchery raised rainbows in the upper reaches of West Fork Eagle Creek and main Eagle Creek tributaries (ODFW 2016). In 2016, 4,000 adult rainbows were put in Eagle Creek in the first week in July (ODFW 2016).

In addition to fish bearing stream habitat, there are 7.5 miles of Category 2 streams, and 15.2 miles of Category 4 streams in the project area. Category 1 and 2 streams in the analysis area are displayed in Table 4.

Table 4. Category 1 and 2 streams and miles in Two Eagle Project Area

Major Stream	Stream Category	Miles	Major Stream	Stream Category	Miles
Basin Creek	1/2	1.0/2.8	Two Color Creek	1	.2

Major Stream	Stream Category	Miles	Major Stream	Stream Category	Miles
Eagle Creek	**1**	**6.0**	**West Eagle Creek**	**1**	**5.0**
Grove Creek	1	1.6	Unnamed	1/2	2.2/4.7
Jim Creek	1	1.6	**Total**	**1**	**19.8**
Trout Creek	1	2.2		**2**	**7.5**

*Streams in bold are DCH for bull trout

The majority of streams in the analysis area are higher gradient streams with gradients above 2%. Stream reaches with gradients < 2% are normally considered to be response reaches (e.g. Rosgen C channels) whereas stream reaches with gradients >2% are considered to be transport reaches.

In general, perennial streams in the analysis area typically have well developed riparian areas and floodplains. Conifers are the dominant vegetation outside of RHCAs. The average height of site potential trees adjacent to both perennial and intermittent streams is 80 to 100 feet. Conifers typically provide shade and woody debris inputs to the channel and riparian area. Riparian obligate vegetation such as willows, sedges, and alders provide bank stability, shade, and nutrient inputs for streams. Intermittent drainages have less well-developed riparian vegetation, often not supporting riparian obligate vegetation due to the lack of year-round flow. Ephemeral draws often have no riparian vegetation associated with them because water is only present following large rainfall or spring-snow melt events.

Critical aquatic habitat elements as defined by the Wallowa-Whitman National Forest 1990 Land and Resource Management Plan ("Forest Plan"; including the 1995 INFISH amendment) and the 1995/98 Biological Opinions (BOs) for the Forest Plan include: 1) pool frequency, 2) water temperature, 3) large woody debris, 4) bank stability, 5) width to depth ratio, and 6) fine sediment levels. These habitat elements are indicators of aquatic habitat function and health for this analysis.

Stream surveys have been completed on all fish-bearing streams in the project area. The most recent stream survey data for fish-bearing streams data are summarized in Table 5. Stream survey data is dated for Cow Creek, predating the 1996/97 New Year's flood event. Eagle Creek, West Eagle Creek, Trout Creek, Jim Creek, and Grove Creek have had recent stream surveys.

Fish habitat in the analysis area does not meet INFISH Riparian Management Objectives (RMO) for pool habitat and width-to-depth ratio (Table 5). LWD levels meet the RMOs in Trout Creek, Eagle Creek, and Cow Creek. In general, pool habitat increases as LWD increases (Dollof and Warren, 2003). However, there does not appear to be a relationship between LWD and pool habitat in steeper streams (Montgomery et al., 1995) or in streams with low stream power (Jackson and Sturm, 2002). As noted earlier, the majority of streams in the analysis area are high gradient streams, including fish-bearing streams which have been surveyed (Table 5), which may reduce the pool forming function of LWD.

A pool habitat analysis was completed in the Eagle Creek Watershed Analysis (1997). Relationships between pool frequency, large woody debris, stream width, and stream gradient were analyzed to determine if these stream characteristics were correlated. Small woody debris (6 – 12" diameter, 20 – 35 ft long) and wetted stream width were found to be significant predictors of pool frequency. Pool frequency was not related to LWD and total LWD (i.e. sum of small and large size class LWD). INFISH LWD size class is >20" diameter and >35 ft long. While a causative factor for low pool frequencies was not identified in the watershed analysis, pool habit has likely been reduced by past management activities.

Table 5. Habitat Summary data for Category 1 streams in the Two Eagle Project area

Stream Name	Year of Stream Survey	Distance Surveyed (Miles)	Ave Wetted Width	Pools/Mile	Pieces LWD/Mile	% Particles <5.7 mm	W/D Ratio	Streambank Stability	Median Gradient[1]
Eagle Creek	2016	4.8	43.6	4.2	21.2	8.1	50.6	82.8%	1.6%
West Eagle Creek	2014	7.3	19.5	27	5	29.3, 16.8, 14.0, 37.0, 54.4, 35.6	32.8	98.6	
Trout Creek	2015	3.6	9.8	28	25	37.4, 24.150.8	12.9	93	
Grove Creek	2015	1.3	6.7	49.3	13	25.7, 52.9, 25.0	8.8	95.5	
Cow Creek	1991	0.4	4.9	32.1	168	N/D	6.5	81-94%	5.7%
Jim Creek	2015	2.8	5.5	50.4	5	34.8, 55.3	9.3	89.9	9.0%
RMO/Indicator				See Note 2	≥20	<20%	≤10	≥80	N/A

Shading indicates where a habitat element is meeting Forest Plan RMOs. N/D = No data.
1) Based on stream segment surveys
2) RMO based on stream wetted width: < 10 ft, > 96 pools/mile, 10 to 20 ft, 56 to 96 pools/mile, 25 to 50 ft, 26 to 47 pools/mile

Fine sediment data for streams that have been surveyed in the project area are displayed in Table 5. These substrate measurements are taken at channel cross sections at locations that represent the character of the survey reach. West Eagle Creek, Trout Creek, Grove Creek, and Jim Creek have multiple cross sections and associated substrate data (minimum 100 particle size measurements evenly distributed along channel cross section). The Eagle Creek survey substrate data indicates that fine sediment levels are low to moderate. Two channel cross sections on West Eagle Creek were <20% fines. All other cross sections were over the 20% fines threshold, several by a very large margin.

Half of streams surveyed in the analysis area do not meet the INFISH RMO for width-to-depth ratio (<10, Table 5). However, the INFISH RMO was developed prior to advances in our understandings of the relationship between width-to-depth ratios and natural channel forms (Rosgen 1996). Normal ranges for width-to-depth ratios (bankfull width) for Rosgen B and C channels are 12 to 20 and 13.5 to 28.7, respectively (Rosgen, 1996). All surveyed streams in the analysis area, except Eagle Creek and West Eagle Creek, are within the normal range for width-to-depth ratios for their respective Rosgen channel types. Eagle Creek has a mix of Rosgen C and B channel types which may partially explain the higher than normal width-to-depth ratio. The width-to-depth ratio for the 2016 Eagle Creek survey is much higher than the normal range; 50.6 compared to 20 for Rosgen B channels and 28.7 for Rosgen C channels. The June 2010 flood event took out some of the road template on Forest Road 77 and likely scoured out the banks and widened the bankfull channel in places which may have increased the width-to-depth ratio.

Observations made during the stream evaluations and stream survey data within the project area indicated that stream stability was generally high and met the 80% stability standard (Table 5). Many of the streams are located in inner gorges, and have rocky well-vegetated banks typical of Rosgen B-type channels.

A. Water Yield and Streamflow

The climate of the project area has four distinct seasons and is characterized by dry warm summers, and cold winters with a consistent snowpack forming each year. Annual precipitation amounts vary from near 25 inches at lower elevations to over 40 inches at higher elevations. Most of the annual precipitation falls as snow. Streamflow discharges in project subwatersheds are characteristic of a snowmelt hydrograph,

with late spring and fall rains contributing to the annual average flows. Peak flows usually occur in May and June and subside to baseflows by late July. Minimum discharges occur in late August and September.

The Phillips-Ingle Ditch Diversion is a major irrigation ditch running through project area that is fed by a network of smaller streams and intercepts everything along the hillslope. The point of diversion is West Eagle Creek. A stream spanning dam occurs on West Eagle Creek at the point of diversion. The diversion takes nearly 100% of the flow from West Eagle Creek. A small amount of water flows through/beneath the bypass channel. In addition, Grove Creek is diverted above the 7700 road and is captured in a ditch and routed upstream of the diversion, illegally. There is not a water right for Grove Creek. The Watermaster for the Powder River Basin was notified of this on October 19, 2017.

B. Erosion and Sedimentation

Past timber harvest and associated roads have increased sediment delivery from logged watersheds during and after past projects in the project area. Excessive sediment can negatively affect beneficial uses of water including fish habitat, municipal water use, irrigation water and other uses. There are areas where the Phillips-Ingle Ditch has overtopped and eroded the hillslope below. There are also dry, abandoned channels downslope of the ditch that were observed in the project area during the summers of 2015 and 2017.

INFISH Standards and Guidelines for existing roads within RHCAs include minimizing sediment delivery to streams from the road surface, closing and stabilizing, or obliterating and stabilizing roads not needed for future management activities, improving stream crossings to accommodate a 100-year flood, and providing and maintaining fish passage at all road crossings of existing and potential fish-bearing streams.

C. Channel Stability/Function

Channel stability helps define the level of function of stream systems. Inherent channel stability is characterized by recognizing channel classification. This means that inherent stability can vary by stream type. Streams in the project area are mainly Rosgen A and B type channels. These streams are characterized by entrenched to moderately entrenched (limited floodplain access), low-moderate width/depth ratios, low-moderate sinuosity, and stream slopes less than 10%. Substrates generally consist of cobbles and gravels, with minor amounts of boulders and fines. Stream stability in these stream types depend on bank and bed rock content, with some stability a function of streamside vegetation and LWD. In a natural state, these stream types tend to show good to excellent stability.

Stream stability is generally good throughout the project area (>80%), with some exceptions on Eagle Creek where the valley bottom width exceeds about 200 feet. These reaches often function as bedload deposition zones, causing increased lateral migration and braiding of the channels. While some of this instability is influenced by human activities, it appears that some natural instability is inherent with the system. For example, stream stability for the reach immediately above the Main Eagle trailhead exhibits braiding and lateral migration. This reach is not influenced by management actions. The interaction of the stream and Forest Road 77 has caused problems in terms of maintaining the road. During the flood event of June, 2010, partial loss of the road template occurred in four different places. The volume of material lost from the road template from these sites is in the thousands of yards, based on reconnaissance level estimates.

D. Water Quality and Beneficial Use

Congress has designated the State of Oregon as having responsibility to implement the Clean Water Act (CWA). The Clean Water Act requires that water quality standards be developed to protect beneficial uses and a list be developed of water quality impaired streams (303(d) list). When water quality standards are not met the CWA further requires development of Total Maximum Daily Loads (TMDL) for the

pollutants (calculated pollutant amounts or surrogate criteria that a water body can receive and still meet Oregon water quality standards). Water Quality Management Plans (WQMPs) are developed by the US Forest Service after the TMDL process is complete to identify measures to improve water quality.

Water quality standards are on ODEQ's website and are updated throughout the year:
http://www.deq.state.or.us/wq/standards/standards.htm

The 2012 Integrated Report and 303(d) list has been submitted to EPA. Parts of the list were approved and parts were not approved.

Beneficial use designations are also on Oregon Department of Environmental Quality's (ODEQ) website:

Powder/Burnt Basin OAR 340-041-0260 tables and figures
http://www.deq.state.or.us/wq/rules/div041tblsfigs.htm#t1

Impaired Waterbodies – 303(d) Category 5 Streams

ODEQ submitted the 2012 list to EPA for approval in November 2014. Some parts were approved and others were not approved. In the planning area river mile (RM) 0 to 21.1 of Eagle Creek was the only category 5 303(d) listed stream. Samples indicated there were exceedances for the amount of *E. coli* in Eagle Creek. The listing is based on samples taken at ODEQ Laboratory Analytical Storage and Retrieval (LSSAR) station 36193 which is located on Eagle Creek south of the town of Richland, Oregon. *E. coli* generally arises from fecal contamination by warm-blooded animals and nonpoint bacterial pollution, such as *E.coli*, has been found to be related to livestock grazing on public lands (Stephenson and Rychert 1982). Eagle Creek is at RM 12 when it flows off from US Forest Service land and there are abundant agricultural lands between the sample site and the USFS boundary that could contribute to the elevated E. coli level.

Since this is a category 5 listing, a Total Maximum Daily Load (TMDL) has been initiated (initial scoping and data collection phase). Once the TMDL is approved, a Water Quality Management Plan (WQMP) covering US Forest Service lands within the Powder Basin will be completed by USFS staff and will follow standards and guidelines (S&G) as listed in the LRMP (amended by INFISH) and Best Management Practices (BMPs) as defined in the Implementation Plan for CWA Section 208 (Federal Water Pollution Control Act, PL 92-500, as amended (1987), to ensure water quality standards are met. Habitat conditions are expected to be improved through implementation of BMPs. PACFISH/INFISH Biological Opinions provide management direction in the form of interim Riparian Habitat Conservation Areas (RHCAs) and associated standards and guidelines.

Water Quality and Beneficial Use Support Summary

Oregon's 2012 Integrated Report and 303(d) list are available for review online at http://www.oregon.gov/deq/wq/Pages/2012-Integrated-Report.aspx. Refer to ODEQ (2011) for a description of their assessment process. EPA recognizes 5 assessment categories. All uses are supported in Category 1 (ODEQ does not use this category). Category 2 waters have some uses supported and the water quality standard is attained. Category 3 waters have insufficient data to determine if uses are attained or not attained. Water quality limited streams are assigned category 4 or 5. Category 4 has 3 subcategories: 4A – TMDL that will address water quality standards is approved; 4B – other pollution requirements are expected to attain water quality standards; 4C – impairment not caused by a pollutant. Category 5 water bodies are water quality limited and require a TMDL and these streams are placed on the 303(d) list. The primary pollutants of concern are bacterial *E. coli* in Eagle Creek.

E. Stream Temperature

To meet the Clean Water Act, the beneficial uses of waters must be identified and management activities planned so they will not interfere with or be injurious to the beneficial uses of adjacent and downstream waters. The relevant beneficial uses of the Powder/Burnt Basin and its tributaries as determined by

Oregon Department of Environmental Quality are: 1) Public and private domestic water supply; 2) industrial water supply; 3) irrigation; 4) livestock watering; 5) fish and aquatic life; 6) wildlife and hunting; 7) fishing; 8) boating; 9) water contact recreation; 10) aesthetic quality (ODEQ, 2003). Beneficial uses within the project area include livestock watering, irrigation, and resident fish and aquatic life. There are no streams listed on the 2010 ODEQ 303 (d) list as water quality limited for temperature in the project area.

The ODEQ water quality standards are applied to protect the most sensitive beneficial uses in a waterbody. Bull trout are considered the beneficial use most sensitive to stream temperatures in the project area. The biologically-based criterion requires that the seven-day moving average of the daily maximum temperature shall not exceed 53.6°F (12.0° C), Table 6.

Table 6. ODEQ temperature standards for streams in the Two Eagle project area.

Fishbearing Streams in Project Area of Subwatershed	Temperature Standard Water Bodies Must Not Be Warmer Than: (Maximum Weekly Average Temperature)
Eagle Creek	53.6^{0}F- for native Oregon bull trout
West Eagle Creek	53.6^{0}F- for native Oregon bull trout
Trout Creek	53.6^{0}F- for native Oregon bull trout
Jim Creek	53.6^{0}F- for native Oregon bull trout
Grove Creek	53.6^{0}F- for native Oregon bull trout
Glendenning Creek	53.6^{0}F- for native Oregon bull trout

There are eight temperature monitoring sites within the project area, see Table 7. Limited water temperature monitoring has occurred in the Eagle Creek system, including the analysis area (Table 6). Within the analysis area there are six water temperature monitoring sites, three on West Eagle Creek, one on Eagle Creek, one at the mouth of Trout Creek, and one on Glendenning Creek. Four of the sites have one year of monitoring (2017). Water temperature data indicates that the bull trout standard (<53.6 °F) is not being met in Two Eagle Creek in the analysis area (Table 7). The water temperature standard was exceeded every year in Eagle and West Eagle and in 2017 in the streams that were sampled in the analysis area. Water temperatures in Eagle Creek appear to be naturally warm based on temperature data from Eagle Creek site 14K.8 which is located near the wilderness boundary and upstream of the project area.

Table 7. Maximum 7-day Mean Maximum Stream Temperatures for Two Eagle Compared to ODEQ Standards.

Stream	Site Name	Elevation (ft)	1997 (°F)	1998 (°F)	1999 (°F)	2000 (°F)	2001 (°F)	2002 (°F)	2005 (°F)	2017 (°F)	ODEQ Standard (°F)
Eagle Creek below 77 road	Eagle_L67	5040		N/D	N/D	N/D	63.3	59.7	61.3		<53.6
Eagle Creek downstream wilderness boundary	Eagle.14K.8						63.3	59.7	61.3		<53.6
Eagle Creek at Tamarack Campground	Eagle_Creek_L68		58.53	59.9		58.5					<53.6

West Eagle Creek	West Eagle.14J.2	5120		N/D	57.0	79.14	60.7	58.4	59.7		<53.6
West Eagle Creek below NFR 67	West Eagle Creek_L69_WT		62.9	64.29						62.1	<53.6
West Eagle Creek above Trout Creek	West Eagle 14J.3			61.2						61.1	<53.6
Phillip-Ingle Ditch	Phillip_Ingle 29E.1							60.6			<53.6
Glendenning Creek	Glendenning Creek									54.1	<53.6
Trout Creek at mouth	Trout Creek									58.0	<53.6

N/D = No data

Environmental Effects

Assumptions

The analysis area for watershed processes encompasses three subwatersheds, Bennet Creek-Eagle Creek, Upper Eagle Creek, and West Eagle Creek, in the project area. Effects to aquatic habitat are unlikely to stop at the downstream boundary of the project area. Indicators assessed for the aquatics effects analysis are assessed at a reach scale, where that information occurs, but also at the subwatershed scale. Measurable effects to aquatic habitat from proposed activities are not expected to extend downstream of the project area.

Direct effects to fisheries and water resources are primarily related to sediment input from project actions which occur at the same time and place as these resources. Indirect effects are primarily related to sediment and stream temperature impacts which are caused by the action and are later in time or farther removed in distance. Cumulative effects are from present and reasonably foreseeable future actions that overlap in time and space with the effects of the Sparta project.

Time frames for the direct/indirect effects discussion for watershed processes and aquatic habitat are: 1) short-term, 0 - 5 years; 2) mid-term, 5 - 10 years; and 3) long-term, >10 years.

Sediment Delivery Rates: The definition of accelerated sediment delivery for the Two Eagle Project includes any increase over and above the natural sediment rates of the watershed.

It is difficult to equate soil erosion directly to sedimentation rates. Obstructions in the path (i.e. downed wood, grass/forb cover) between the sediment source and the stream reduce the risk of indirect sediment delivery to the stream. Therefore, adequate filter strips (in terms of size, ground cover and downed material) are necessary to slow or prevent sediment movement downslope of disturbed areas. The use of the riparian buffers described above has long been recognized as a mitigation measure to reduce sediment transport to streams. The structural complexity of roots and herbaceous vegetation, in addition to the absorption capability of the duff layer, limits excess sedimentation to the aquatic system. Surface runoff slows down when it comes in contact with herbaceous shrubs, mature trees and the duff layer on the forest floor and sediment is deposited within the riparian buffer before it reaches the watercourse (Decker 2003).

Direct and Indirect Effects to Watershed Processes, Fish, and Aquatic Habitat

A. Water Yield and Streamflow

Methodology and Measurement Indicators

The Equivalent Clearcut Area (ECA) methodology (King, 1989) provided an initial screening for any predicted changes in the streamflow regime as a result of proposed activities. If ECA thresholds are met or exceeded, further analysis and/or monitoring will help determine the degree of change and potential issues with stream function and stability. In general, an ECA >15% indicates risk that water yield may increase above background levels.

Alternative 1- No Action

Alternative 1 does not implement any vegetation management, prescribed burns, temporary road construction, road maintenance including culvert installation and removal, road decommissioning or aspen enhancement activities. All current management activities would continue in the project area. Activities include livestock grazing, diversion of water out of West Eagle and Grove Creek, via the Phillips-Ingle Ditch for irrigation purposes, recreation, woodcutting, road maintenance, and wildfire suppression. While some repair of Forest Road (FR) 77 occurred in 2012, other road improvements including drainage and stabilization are not planned. Since current activities would continue, no changes in water yield or streamflows would occur in the short-term.

Without treatment of fuels and overstocked stands, the risk for fire, including uncharacteristic severe fire is subject to increase over time (See Fuels section). Whether uncharacteristic high-severity fire could translate into a change in soil-water function at a scale sufficient enough to affect the streamflow regime would require the entire sequence of events to occur: 1) A fire that covers a large enough portion of watershed to produce potential effects. 2) Burn severity of moderate to high on 50% or more within the burn perimeter. 3) A storm event or rapid snowmelt of sufficient intensity that occurs within 3 years of the fire. Recent wildfires in the western United States often result in up to 50-60% of the burned area in moderate to high burn severity (Lentile et al., 2007). For these reasons, it becomes difficult to quantitatively predict risks to watersheds by not treating fuels and overstocked stands. Other potential future effects like changes in stream temperature or LWD recruitment are better correlated to deterministic post-fire situations, but remain subject to spatial and magnitude variations in fire behavior.

A large wildfire event could affect streamflow regimes with possible higher peak flows, higher base flows (due to reduced transpiration), and greater annual volume amounts. In the absence of large wildfires, stream discharges are expected to follow current flow regimes.

In summary, streamflow regime indicators would likely remain in the current range. In the event of a wildfire with sufficient scope and intensity to produce watershed effects, all indicators would experience some degree of effects. Predicting those effects to any degree of certainty becomes problematic due to all the variables involved.

Alternatives 2, 2m and 3

There would be no direct effects to streamflow or water yield by implementing Alternative 2, 2m or 3. No water would be diverted, removed or otherwise decreased or increased in stream channels in the project area.

B. Erosion and Sedimentation

Erosion and sedimentation are geomorphic processes that shape the physical appearance of the landscape and strongly influence aquatic ecosystems. The range of natural variability for sediment delivery to streams and wetlands within the planning area is considered to be very large because erosional processes are influenced by infrequent natural disturbance events such as floods and wildfire. Sedimentation rates to streams are typically inconsequential on a year to year basis but can spike several orders of magnitude during large storm events. Land management has the potential to accelerate erosion rates and the volume of sediment entering streams and wetlands.

Timber harvest activities including harvest, yarding, and haul can potentially increase the delivery of sediment to streams. Harvest attributable erosion and sediment to streams has been shown to increase when ground disturbance is closer to the channel (Rashin et al. 2006). One of the important variables influencing the effects of project activities on hydrology and sediment is proximity of activities to stream channels (Rashin et al., 2006). A research study on buffers found that of 212 erosion features within 10 meters (approximately 30 feet) of a stream, 67 percent of the features delivered sediment to the stream. Of 193 erosion features greater than 30 feet from a stream, 95 percent did not deliver sediment to the stream.

The primary potential source of sediment from harvesting is derived from ground disturbing activities, primarily summer dry season tractor harvest systems, and to a much less degree winter logging.

Rashin et al. (2006) demonstrated the effectiveness of best management practices for controlling sediment related water quality impacts from timber harvest activities. Rashin et al. found that stream buffers were most effective where timber falling and yarding activities were kept at least 10 meters (approximately 33 feet) from streams and outside of steep inner gorges. This 10 meter buffer for ground disturbing activities was found to prevent sediment delivery to streams from about 95% of harvest related erosion features. Of 193 erosion features located 10 meters from the stream channel, 95% did not deliver sediment. Rashin et al. found that virtually all chronic sediment delivery was associated with skid and shovel trails that crossed streams. There would be no stream crossings with equipment of any perennial fishbearing streams within the Two Eagle project area in either alternative.

Lakel et al (2010) studied four streamside buffer widths or streamside management zones (SMZs) for the effectiveness of sediment retention after forest harvest and site preparation. The study was conducted in the Piedmont physiographic region of Virginia. Piedmont soils are highly susceptible to erosion. All SMZs had intact litter layers and were similarly effective for trapping sediment. Side slopes within the study watersheds averaged 25% and ranged from 10% to 65%. The four SMZs studied were:

- 7.6 meters (24.9 feet) with no thinning in the SMZ,
- 15.2 meters (49.9 feet) with no thinning in the SMZ,
- 15.2 meters (49.9 feet) with thinning within the SMZ with 30% to 50% basal area removed,
- 30.4 meters (99.7 feet) with no thinning in the SMZ.

Treatments included clearcut harvest; dozer created firelines between harvest, and SMZs, and prescribed fire. Results indicate that 97% of eroded materials were trapped within the harvest area or the SMZ before reaching the stream, and that pre-harvest and post-harvest sediment data was not significantly different for the four SMZ treatments. Three of the study watersheds had sediment bypass the SMZ regardless of SMZ width and the apparent causes were failed water control structures associated with road segments or firelines on steep, fragile soils that concentrated flow creating scouring and minor channel formation. In contrast, there would be no dozer created fire lines within the Two Eagle project area during harvest activities. No active lighting would take place within RHCAs. Upland prescribed fire units would be ignited as determined in prescribed fire burn plans, down to the outer RHCAs. Within RHCAs fire would be allowed to continue to burn and spread, usually as a backing fire, without further influence from ignition sources. Fire backing into RHCAs would be low intensity fire. Under circumstances where unmanipulated fire activity threatens to exceed maximum burn prescription parameters and/or control of the burn is threatened, hand ignition would continue into the RHCA as necessary. Instances of hand ignition within RHCA buffers is expected to be rare and typically only occur with unexpected changes in wind direction.

Roads can also be a substantial source of sediment as well as a mechanism for delivering sediment to the stream systems. Forest roads affect surface runoff patterns, erosion, and sedimentation that may affect aquatic organisms (Trombulak and Frisell, 2000). Roads can also serve as a link between sediment sources areas and stream channels through sediment delivery (Wemple et al., 1996).

Forest road impacts on sediment yield often correlates with road density within RHCAs and the number of stream crossings (Furniss et al., 1991). Additionally, the connectivity between roads and streams can be affected by soil conditions, slope steepness, and road standards. The distance that sediment travels from road sources is a function of volume, obstructions, hillslope gradient, and source area (Megahan and Ketcheson, 1996). Roads can directly affect channel morphology by accelerating erosion and sediment delivery and by increasing the magnitude of peak flow (Furniss et al., 1991).

Alternative 1

Alternative 1 does not implement any vegetation management, prescribed burns, temporary road construction, road maintenance, or cottonwood enhancement activities. All current management activities would continue in the project area. Activities include livestock grazing, diversion of water out of West Eagle Creek and Grove Creek via the Phillips-Ingle Ditch that traverses the project area to the west and south of West Eagle Creek for irrigation purposes in the Keating Valley, recreation, woodcutting, road maintenance, and wildfire suppression. Some repair of FR 77 that was damaged in the 2010 flood have occurred, but other improvements including drainage improvement are not planned.

The amount of sediment entering the streams under the Alternative 1 is expected to remain the same unless there is 1) an increase in grazing use and grazing pressure tributary stream banks in the project area, 2) road failures, 3) landslides, 4) increase in mining activity and/or 5) a wildfire. Inputs of sediment from livestock use in the analysis area are minimal because steep hillslopes, conifers, and narrow valley widths along tributary streams limit access to the stream banks in most places.

Sediment inputs as a result of a wildfire vary depending on the severity of the burn and its areal extent. Site factors contributing to post-fire soil erosion include burn severity (changes in soil-water function), loss of ground cover, slope and magnitude/duration of precipitation events. Post-fire sediment delivery to streams can increase due to high erosion rates and less ability to capture sediment on hillslopes. The recovery of sediment inputs to pre-fire levels is anticipated at about three years after a low-severity wildfire and 7 to 14 years after a moderate or high-severity wildfire respectively (Robichaud et al. 2000).

The risk for uncharacteristic, high intensity fire is higher under Alternative 1. This represents an increased risk of sediment delivery if a fire and subsequent storm event scenario occurred. Without treatment of fuels and overstocked stands, the risk for fire, even uncharacteristic high-severity fire is subject to increase over time (See Fuels section). Whether uncharacteristic sever fire could translate into a change in soil-water function at a scale sufficient enough to affect flow and sediment regimes would require the entire sequence of events to occur: 1) A fire that covers a large enough portion of watershed to produce potential effects. 2) Burn severity of moderate to high on 50% or more within the burn perimeter. 3) A storm event or rapid snowmelt of sufficient intensity that occurs within 3 years of the fire. Recent wildfires in the western US often result in up to 50-60% of the burned area in moderate to high burn severity (Lentile et. al., 2007). For these reasons, it becomes difficult to quantitatively predict sediment risk to watersheds by not treating fuels and overstocked stands.

Roads will continue to serve as a conduit for and source of fine sediment to the streams under this no-action alternative. The amount varies depending on road location, design, and maintenance. No increase in the road-related sediment to the stream is anticipated unless there is a road or culvert failure during a storm event, or the deterioration of a road due to lack of maintenance erodes and contributes sediment. Sediment inputs from the tributary streams are expected to be minimal because there are no ongoing activities that will remove vegetation along riparian buffer zones or stream banks.

Alternative 2, 2m and 3

Commercial and Non-Commercial Harvest Activities

There are no timber harvest activities that could have direct effects on water quality. Any effect to water quality would be indirect in nature, occurring later in time or farther removed in distance from stream channels. There are no direct effects to fish and aquatic habitat resulting from timber harvest activities in Alternative 2, 2m or 3, all effects would be indirect in nature. Sediment and soil compaction or exposure caused from ground disturbance in commercial harvest units in the project area could reach stream channels in a run off event, effecting water quality, fish, and fish habitat.

Timber harvest activities using mechanical equipment would occur on 1,507 acres in Alternative 2, 1,869 in Alternative 2m, and 1,167 in Alternative 3. Default INFISH RHCA widths (see Table 3) will be utilized as no activity buffers to protect aquatic and riparian habitats in the project area from receiving measureable increases in fine sediment. The only exception would be in Alternative 2 and 2m, where small patch opening for cottonwood and western larch trees would occur in units 84, 95, 112, and 113. These units comprise 8 acres within RHCAs, the majority within Category 1 Eagle Creek, however only 2 acres would be commercially treated. These two acres would receive minimal extraction of commercially merchantable conifers trees that could be reached from the road prism. In units 95, 112 and 113, equipment would stay on the 770000 road and harvest trees within a 20 foot radius of existing cottonwood trees. In unit 84, an existing temporary road on the east side of the unit would be used. Equipment would stay on the road to avoid ground disturbance and the only harvest that would occur would be commercially viable trees surrounding cottonwood trees that can be reached from the existing temporary road. There would be no mechanical entry into RHCAs in these units. These trees would be harvested using near full suspension to avoid ground disturbance. The remaining 6 acres would be thinned using hand thinning to create patch openings around western larch and cottonwood trees. In Alternative 3, one acre (unit 84), would have commercial harvest in RHCAs.

There are no landings to support timber harvest activities within any units in any alternative.

When INFISH was developed in 1995, the widths of RHCAs were thought to be sufficient to maintain or restore water quality and aquatic habitat (large woody debris (LWD), pools, fine sediment) (INFISH, 1995). Reviews by Rhodes et al (1994), Rhodes (1995), Moyle et al. (1996), and Quigley et al. (1997) questioned the effectiveness of the PACFISH/INFISH RHCA width for Category 4 streams for preventing the transport of nonchannelized sediment to Category 4 stream channels and ultimately Category 1 streams. The main criticism of RHCA widths for Category 4 stream channels is that additional buffer width is needed on steeper slopes to protect against fine sediment reaching stream channels. Rhodes et al. (1994) and Rhodes (1995) suggest that to provide "completely natural levels" of fine sediment reaching streams a buffer width of 450 feet (slope distance) is required. Erman et al. (1996) suggests adding additional buffer width (slope distance) as slope and soil erodibility increase.

In response to these reviews, the proposed decision for the Interior Columbia Basin FEIS provided a relationship developed for highly erodible soils and slope as a default for determining widths of Category 4 RHCAs needed to achieve a low risk of sediment reaching stream channels (ICBEMP, 2000). Compared to the "low risk" default widths recommended by ICBEMP, the width of INFISH Category 4 RHCAs likely represents a moderate risk of fine sediment reaching Category 4 stream channels in the project area in Alternatives 2, 2m, and 3.

In addition to the importance of vegetated buffer widths for filtering fine sediment prior to reaching Category 4 streams, levels of LWD in Category 4 stream channels can also play an important role in trapping and storing fine sediment. As noted in the Aquatic Habitat section, LWD levels in Category 4 streams are at low levels. In the Two Eagle project area there are 15.2 miles of Category 4 streams. The majority of units were drawn around the 100 foot buffer, therefore there is a very minimal amount of

category 4 streams within units. Effects to water quality or downstream Category 1 fish habitat from sediment entering stream channels is expected to be negligible. The INFISH 100 feet buffers is expected to be adequate to protect water quality and avoid sedimentation into Category 1 channels.

Any potential effect to water quality and fish habitat from timber harvest activities in Alternative 2, 2m, and 3 would be indirect in nature. INFISH standards and guidelines for timber harvest activities and RHCAs were developed to limit impacts to aquatic habitat from timber harvest activities. Additional design features have been incorporated into the proposed action to limit soil disturbance from proposed activities in RHCAs. There is an extrememly low likelihood that increases in fine sediment resulting from the proposed timber harvest activities would result in measureable increases in fine sediment in fish bearing streams in the analysis area.

Mule Deer Treatment

In Alternative 2m, 27 acres of conifer thinning would occur on the east side of Eagle Creek to enhance mule deer fawning areas in units M1, M2 and M3. About half of the acres in unit M1, the largest meadow, are outside of the RHCA, all of unit M2 is within the RHCA, and most of unit M3 are within the RHCA. Thinning would be done by hand. Lodgepole pine and grand fir under 9 inches dbh would be thinned. There would be no thinning within one site potential tree height of the stream. Trees that would be thinned range from 80 feet to over 300 feet away from Eagle Creek. Because of the no activity buffer within one site potential tree height, and because only hand thinning would occur in these units, there is not expected to be any increase in erosion and sediment to the stream channel from these activities in Alternative 2m.

Transportation Systems

Road Reconstruction

Minimal maintenance of roads would be required to open closed roads in alternatives 2, 2m, and 3. The majority of maintenance activities such as brushing, blading and shaping of the road surface, cross drain culvert cleaning, and limited ditch cleaning would not occur instream but would occur on the road prism or immediately adjacent to the road prism and would not result in direct effects to water quality, fish or fish habitat. These road maintenance activities are a potential indirect effect. Culvert installation would be required on certain roads proposed to be opened in all alternatives; this would have direct effects on water quality due to the instream work associated with installation (see *Culvert Replacements* below).

Road maintenance is necessary to keep roads in good condition, minimize erosion, and identify and correct problems promptly (Furniss et al. 1991). Maintenance keeps roads in a condition suitable for travel and prevents severe erosion from failure of the drainage system (Luce and Black 2001). In Alternatives 2 and 2m, 1.7 miles of road reconstruction would occur. In Alternative 3, 0.7 miles of road reconstruction would occur. Approximately .4 miles of road reconstruction on open (ML 2) roads would occur within RHCA buffers in Alternative 2 and 2m and Alternative 3. This includes 0.33 miles of reconstruction work on the 7700000 road that is within Category 1 fish bearing stream (Eagle Creek) RHCAs and less than one tenth of a mile in Category 4 RHCA.

Blading consists of pulling material from the sides of the road inwards to redevelop the road crown. All material would remain on the road surface. Luce and Black (2001) observed that blading of only the traveled roadway on an aggregate surfaced road with well vegetated ditches yielded no increase in sediment production from a complete road segment, while blading of the ditch, cutslope, and traveled roadway substantially increased sediment yield from road segments. Results from a study conducted by Luce and Black (2001) suggest that blading the ditch has a greater effect than traffic on sediment yield, and that ditch grading can increase sediment yields on a level comparable to or greater than wet weather hauling. Cleaning ditches and removing the cutslope vegetation caused a dramatic increase in sediment

production. Sediment yields from older roads with undisturbed ditchlines are much smaller than sediment yields from newer roads or roads with disturbed ditchlines. Disturbance of the road surface alone through grading showed less effect. No cutslope grading or removal of vegetation from cutslopes is proposed for closed roads that would be opened for administrative purposes. No widespread ditch cleaning is proposed for closed roads. Only small scale, local, and scattered ditch cleaning may be needed. The majority of vegetated ditchlines would remain to trap sediment before reaching streams.

Brushing out of the road prism would not cause ground disturbance. Vegetation is trimmed back approximately six feet either side of the traveled roadway. Removal of some vegetation (brushing) may be needed where the closed roads cross through RHCAs. Vegetation would only be removed where it has grown over or into the road prism making travel difficult. No streamside vegetation would be removed. Only vegetation within the road prism would be removed and would have no effect on stream temperature. Intermittent non-fishbearing streams within the project area are typically dry by the middle of June and do not contribute to summer stream temperatures and are therefore not an issue for maximum stream temperatures.

Spot rocking would prevent rutting, erosion and puddling of the road surface. Swift (1984) investigated the influence of graveled, ungraveled, and grassed road surfaces on soil erosion. The study concluded that the graveled road surface with vegetated sideslopes have the lowest soil loss compared to ungraveled and grass road surfaces.

The most common issue found during road inspections in the Two Eagle project area was a lack of defined drainage either through poor design and/or lack of maintenance. Many critical road segments have a neutral profile, meaning they are neither outsloped or insloped. The result is water often tracks down the road surface for extended distances, creating more energy for scour and transport of road material.

Because there is such limited road reconstruction activities proposed in any alternative, it is unlikely that a result in an increase in disturbed areas contributing to erosion rates would occur in the short or long term. Improved drainage is expected to reduce sediment delivery to stream channels and reduced erosion of the road surface by directing water off of the road surface.

Use of BMPs such as conducting activities when streamflows are low, development of a Pollution and Erosion Control Plan (PCEP), delineating construction impact areas on project plans and confining work to the noted area, and rehabilitation of disturbed areas by mulching and seeding would minimize sediment yield. Vegetation will only be removed if necessary to complete realignment. Culverts would be sized to prevent the degradation of streambanks and maintain integrity of the stream channel and stream processes. Culvert installation and removal would occur during the instream work window specified in Oregon Department of Fish and Game Guidelines for Timing of In-Water Work (2008). In the long-term, road maintenance activities would reduce adverse effects to aquatic habitat by reducing overall erosion rates from the road system.

Opening Closed Roads

Fine sediment levels in streams have been shown to increase as the density of roads in a watershed increase (Cederholm and Reid, 1987). No new system roads would be constructed in either alternative; however, 15.33 miles of currently closed roads would be reopened to access harvest units in Alternative 2 and 2m and 8.42 miles of closed roads would be reopened in Alternative 3. Approximately 1.5 miles of currently closed roads that would be opened for hauling activities are located within Category 1, 2, and 4 RHCAs. Approximately 0.7 miles of road that will be opened and used for hauling are within 300 feet of Category 1 fishbearing streams. The longest segment is on the 7700550 road (0.38 miles) that parallels Cow Creek, a Category 1 fishbearing stream. All other segments cross less than 0.1 miles of RHCA, where a road crosses a stream, rather than where a road is parallel to a stream. In Alternative 3, 1.08 miles

of road in RHCAs that are currently closed would be opened for hauling purposes and reclosed when the project is completed. The decreased amount of closed road to open in Alternative 3 is due to units that are planned for commercial harvest in Alternatives 2 and 2m changing to non-commercial and therefore these roads would not be used for haul or for equipment access. Instead these units would be accessed by foot travel and thinned by hand crews. Closed roads that are opened for timber sale activities would be closed following completion of timber sale activities.

Opening closed roads for timber sale activities would occur in a phased manner with only a portion being open at any one time. The actions associated with opening and reconstructing closed roads as well as traffic on closed roads associated with mobilizing equipment and log haul could have indirect effects on water quality and fish habitat at stream crossings as well as where roads are adjacent to channels, depending on the proximity and riparian vegetation buffers between the road and stream channel.

Because alternative 2 and 2m have the same amount of miles within RHCAs that would be opened, there is not an expected difference in indirect effects. There would be slightly less effect in Alternative 3, since there are almost .5 less miles of closed road to be opened within RHCAs. Because open road density would be slightly higher for the project in Alternative 2 and 2m than 3, there may be greater levels of overall erosion and fine sediment contribution in the subwatersheds contributed by roads. However, the effects on water quality and fish and fish habitat would likely be immeasurable.

Post sale road decommissioning plan

Table 9. Open Road Densities Pre and Post Project

Subwatershed	Open Road Miles Existing	Open Road Miles Post Project	Open Road Density Existing	Open Road Density Post Project
Bennet Creek-Eagle Creek SWS	14.45	11.3	4.36	3.41
Upper Eagle Creek SWS	8.58	8.32	4.53	4.40
West Eagle Creek SWS	18.44	13.67	3.05	2.26
Total	41.47	33.29		

In all alternatives 11.06 miles of open roads would be used for the project and decommissioned after project completion. This lowers open road density in all three subwatersheds (Table 9). Three and a half miles of ML 1, 2, and 3 roads located in RHCAs would be decommissioned in Alternatives 2, 2m, and 3. This includes 2.65 miles in Category 1 RHCAs. Road miles within RHCAs would decrease in the project area from 19.5 to 16.0 in all alternatives. Road miles within Category 1 RHCAs would decrease from 14.42 to 10.38. Decommissioning of these roads would address hydrologic concerns such as restoring natural hillslope runoff patterns and reducing sedimentation by providing additional drainage such as surface cross drains. Closing and decommissioning these roads to vehicular traffic eliminates incidental sediment delivery to stream channels caused from erosion on forest roads and sediment input where stream channels cross roads or where roads are adjacent to channels in draw bottom areas. Most of these road features would still be on the landscape and could have sediment input if maintenance issues occur such as undersized or plugged culverts, disturbance of run off patterns, lack of ditches and cross drains which cause road prism erosion. All Alternatives have an overall indirect benefit to watershed processes by eliminating incidental sediment delivery from erosion of road surfaces to stream channels at crossings or where roads are in draw bottom areas adjacent to channels. In addition, where culverts are removed due to lack of function (plugged, undersized, for example) when roads are decommissioned and where ditches are fixed as part of project related road maintenance/reconstruction, erosion and sediment issues from roads are expected to be in improved condition post project.

Temporary Roads

To access logging units without existing access roads Alternative 2 and 2m would require construction of 3.5 miles of temporary roads. An additional 1.75 miles of existing non-system roadbeds would be used for temporary road access. In Alternative 3, 2.45 miles of temporary roads would be constructed and 1.12 miles existing road beds would be used. No temporary roads would be constructed in RHCAs. One existing roadbed T-24 is within a Category 1 RHCA for .16 miles. This temporary road is on the outer edge of the 300 feet buffer on the west side of Eagle Creek, upstream of the Eagle Creek and West Eagle Creek confluence. Temporary roads would be obliterated/decommissioned following completion of haul activities. Erosion control, such as seeding or mulching would occur to stabilize obliterated road prisms and prevent erosion. Eroded material is not expected to exit the buffers between the closest adjacent stream channels and the temporary roads. Because erosion and sediment delivery is not expected to impact riparian habitat or stream channels, no direct or indirect effects to water quality or fish and fish habitat are expected in Alternative 2, 2m, or 3.

Culvert Installations on Closed Roads

One culvert on Category 1 stream, Jim Creek, on the 7700462, would be installed. This is a Category 1 fishbearing stream with redband and brook trout, and is less than .25 miles from the West Eagle Creek confluence. The culvert would be temporary, and would follow stipulations in Oregon Fish Passage Policy (ODFW 2017). The ODFW in-water work window guidelines (2008) would be followed; in water work timing window would be July 1 to October 31.

On the 7700520 road a culvert would be installed on a Category 4 tributary to West Eagle Creek. This location is less than .25 miles upstream from the West Eagle confluence.

Two culverts would be installed on the 7700472 and 7700473 roads that are currently closed and would be opened for project activities. These stream crossings are approximately .25 miles upstream from Jim Creek. This tributary to Jim Creek is an ephemeral draw, with no defined channel.

In Alternative 2, 2m, and 3 culverts would be installed temporarily to reopen previously closed roads that cross streams in the project area for haul activities: one culvert on Jim Creek, Category 1 fishbearing, one on a Category 4 stream, a tributary to West Eagle Creek, and two on ephemeral draws that are approximately .25 miles upstream from the confluence with Jim Creek (Table 10). Culverts will be sized appropriately to accommodate 100 year flood event flows and fish passage on Jim Creek. Culverts will be removed after timber sale activities are completed.

Table 10. Culvert Installations Two Eagle Project Area

Stream Category	Road Number	Comments
1 Jim Creek	7700462	No existing culvert
Ephemeral Draw upstream Jim Creek	7700472	Install cross drain, approx. 0.25 miles upstream of Jim Creek
Ephemeral Draw upstream Jim Creek	7700473	Install cross drain, approx. 0.25 miles upstream of Jim Creek
4	7700520	No existing culvert, install temporary culvert, trib to West Eagle approx. 0.25 miles from West Eagle confluence.

Effects would be the same in Alternative 2, 2m, and 3; increases in fine sediment and turbidity would likely result from installation and removal of temporary culverts. The two cross drains installed on the

ephemeral channels are not expected to have any downstream effect on water quality or fish habitat. These areas are flat seeps and do not have stream power or flow to flush sediments downstream to Jim Creek.

Effects to water quality from installing and then removing the culvert on Jim Creek and potentially the Category 4 crossing would be indirect in nature. Stream crossing work associated with culvert removal and installation would be done when the Category 4 intermittent channel is dry. Increased sediment is expected during the first flow/run off event in these channels where disturbed soils could erode. The culvert replacement on Jim Creek, Category 1 fishbearing stream, could have direct effects on water quality, which could indirectly affect redband trout and aquatic habitat, since it is assumed that there will be flow in the channel when in-water work of culvert installation occurs. All effects on water quality, fish, and fish habitat from culvert replacement work would be short term. Foltz (2008) studied sediment concentrations and turbidity changes during culvert removals. The study found that 95% of the culvert related sediment occurred in the first 23 hours after culvert removal in streams where flows were low. Where flow locations were higher, 40-95% of the culvert related sediment occurred in the first two hours. Culvert installation and removal in the Two Eagle project would be similar to the low flow sites, since work would be required to happen during low flows and sediment concentrations and turbidity would be expected to return to preconstruction levels within 48 hours after replacement. Jakober (2002) found that after culvert replacement on the Bitterroot National Forest, sediment concentrations decreased to near pre-project levels within 24 hours.

During installation of the temporary culverts the effects of sediment to aquatic habitat would be reduced using sediment control measures during the construction phase, and timing the construction phase to coincide with the in-water work window for Eagle Creek and tributaries (July 1 – October 31). Long term effects would be mitigated by appropriately sizing the culverts and maintaining them so that they don't get plugged with debris and create erosion problems. Following installation of the temporary culverts, periodic spikes in sediment input are expected during the first winter season in response to precipitation events that may mobilize sediments from disturbed areas. Sedimentation may also occur throughout the site recovery period until fill slopes stabilize (2 to 3 years following installation). An additional spike of sediment input will occur when the temporary culverts are removed. Measureable increases in fine sediment following culvert replacement projects on the Eagle Cap and the Wallowa Valley Ranger Districts rarely extend downstream more than 1/8 mile (0.125 miles), with the majority of impacts occurring along the channel margin, and last until the following spring runoff (Alan Miller, Fisheries Biologist, Wallowa Valley RD).

Watershed Improvement

Two culverts on the 7700 road on Category 1 fishbearing streams, Jim Creek and Grove Creek are undersized and block fish passage at certain flows. These two culverts would be replaced with appropriately sized culverts following the Oregon Fish Passage Policy (ODFW 2017). An undersized culvert that impedes fish passage would be removed on upper Jim Creek on the 7700464 road and the road will be closed (gated). Short term effects would be the same as what is described above for installing the culvert on the 7700462 stream crossing on Jim Creek. Water would most likely be diverted around construction areas and blocknets would be set up and fish would be removed from construction area while culverts were being replaced. Short term sediment pulses would be expected. There would be short term direct effects to water quality when water is returned to the newly installed culvert due to sediment pulses entering the stream from ground disturbance related to culvert installation. There would be long term beneficial indirect effects to fish due to fish passage improvement and enhanced upstream migration.

Meadow Restoration which would occur in Alternatives 2, 2m, and 3 would address damage to riparian areas of Eagle Creek from ATV and motorized use. In the wet meadow area along the 7755-075 spur, sod

would be used to slow water energy and disperse water in the area of the wet meadow. This would decrease the amount of compaction of wet soils and erosion and sedimentation that is occurring from vehicles driving through this area. This road would be decommissioned to eliminate access to this area. Motorized activities would also be eliminated in the wet meadow behind the Two Color Guard Station. Sod would be placed throughout the downcut channel to slow water flows, disperse water, and agrade the channel to naturally back up and store sediment. These activities would eliminate sources of sediment entering streams and floodplain in the Eagle Creek RHCA.

Prescribed Fire Activities

Prescribed burning to reduce natural fuels levels would occur across about 5,105 acres in Alternative 2, 4,961 acres in Alternative 2m, and 4,087 in Alternative 3. Of these total acres, post-harvest burning of piles would occur in logging units where slash has been generated to reduce ground fuels, 1,662 in Alternative 2, 1,569 in Alternative 2m and 1,388 in Alternative 3.

The use of prescribed fire would not increase sediment delivery rates to stream channels over and above the natural sediment rates of the subwatershed. Prescribed fire will not be ignited in INFISH RHCAs; however, fire will be allowed to back into RHCAs from adjacent areas. The use of backing fires in RHCAs will reduce fire intensities by reducing fuel loading. Because fire intensity is expected to be low in riparian areas, little effect on riparian conditions would be anticipated. Reduced fire intensities in RHCAs would 1) reduce the potential for mortality of trees that provide shade, 2) reduce the amount of downed woody material consumed, and 3) reduce the amount of burned area in the RHCAs thus reducing the amount of ground cover loss.

Agee et al. (2002) found that understory vegetation in riparian zones tended to be moister later in the season than in drier upland forests. In low elevation, interior forests such as those with ponderosa pine, Douglas fir and grand fir, higher understory foliar moisture in riparian zones should dampen surface fire behavior compared to upland forests late in the dry season. High foliar moisture in understory plants will be associated with lower surface fireline activities as fires approach the riparian zone, even when fire return intervals have been shown to be similar between riparian and upland sites (Olson, 2000).

Prescribed fire units include about 865 acres in RHCAs in Alternative 2, 785 in Alternative 2m, and 537 in Alternative 3 (Table 10). The only burning that would occur in RHCAs is in the natural fuel burn block areas where low intensity fire would be allowed to back into the outer edges of RHCAs.

For Alternative 2, the outer edges of 772 acres of RHCA could be effected by prescribed fire treatments. There are 475 acres of Category 1 RHCAs, 135 acres of Category 2 RHCAs, and 161 acres of Category 4 RHCAs that could be impacted by prescribed fire. In Alternative 2m there are 785 acres of prescribed fire treatments that could affect the outer edges of RHCAs including 477 acres in Category 1 RHCAs, 144 acres in Category 2 RHCAs, and 164 acres in Category 4 RHCAs. In Alternative 3, the outer edges of 537 acres of RHCA could be effected by prescribed fire treatments, including 292 acres in Category 1 RHCAs, 128 acres in Category 2 RHCAs, and 117 acres in Category 4 RHCAs.

The following design criteria will be used to reduce impacts to aquatic habitat:

- Use low intensity prescribed fire to reduce fuels loads and reduce the risk of wildfire spread through RHCAs. Limit prescribed fire intensity and spread by using backing fire and not actively lighting in RHCAs.
- There would be no handpiling and burning within RHCAs
- There would be no equipment entering RHCAs in any alternative

Table 11. Acres of Prescribe Fire in RHCAs for Alternative 2, 2m, and 3

Alternatives	Category 1 RHCAs (acres)	Category 2 RHCAs (acres)	Category 4 RHCAs (acres)
Alternative 2	475	135	161
Alternative 2m	477	144	164
Alternative 3	292	128	117

Burn prescriptions have been built to minimize any fire within RHCAs, allowing buffers to capture any sediment generated from upslope areas. The burn prescription would target consumption of woody material 3 inches and smaller with nearly all material in this size class consumed. Therefore, fire severity would not be high enough to consume significant quantities of downed wood that play a role in trapping fine sediment on hill slopes, in intermittent stream channels, and on floodplains. Some ground cover would be consumed but would be quickly replaced as litter fall occurs in the first year following burning and herbaceous plants recover in the second year following burning. A measurable increase in fine sediment in stream channels as a result of burning activities is unlikely due to the combination of a predicted patchy, low severity burn in the outer edges of RHCAs and typical recovery of ground cover within two years of prescribed burning.

Prescribed fire is not expected to be a source of erosion or sediment delivery in any Alternative.

C. Stream Temperature

Alternative 1

No change to current water temperatures would be expected through the mid-term because current management activities within the analysis area would continue. A majority of the timbered stands within the project area are represented by a fuel model that predicts an increased risk of wildfire with moderate to high severities in the long-term (see Fuels Specialist Report). A wildfire in the area could elevate water temperatures for up to 10 years, depending on the wildfire severity (Dunham et al., 2007). Elevated water temperatures for an extended period of time as a result of wildfire could reduce the survival of redband trout until sufficient regrowth of streamside vegetation occurs (See Water Temperature RMO and Aquatic Species).

Alternatives 2, 2m and 3

Commercial and Non-commercial Harvest Activities

Sunlight is the primary energy source that heats streams (Brown and Krygier, 1970). Shading (vegetative and topographic) moderates stream temperatures by reducing the amount of solar radiation from reaching streams. Buffer strips (unharvested or minimally harvested areas) adjacent to streams have been shown to be effective in reducing or preventing increases in stream temperatures from adjacent timber harvest activities. Recommended widths for buffer strips for shading vary from 50 to 250 feet (Pollock and Kennard, 1998). Moore et al. (2005) concluded that based on the available studies, a one-tree-height buffer that preserves shading on each side of a stream should be reasonably effective in reducing harvesting impacts on both riparian microclimate and stream temperature.

The majority of timber harvest activities in Alternatives 2, 2m, and 3 are outside of RHCAs. Two acres of commercial harvest is proposed in units 84, 95, 112, and 113, where trees can be reached from the road prism in Alternatives 2 and 2m. The only RHCA harvest in Alternative 3 is 1 acres in unit 84. The purpose of this harvest is to thin and create patch openings around established cotton wood trees and stands. The remaining 6 acres of these units would be hand thinned where equipment could not reach merchantable trees from the road prism. Thinning would occur approximately 20 feet around cottonwood, western larch, and ponderosa pine trees or groups of these trees. Commercial harvest and non-commercial harvest would occur in the outer edges of RHCAs in Alternative 2, 2m, and 3, leaving minimum no

activity buffers of 100 feet (Category 1 streams), 75 feet (Category 2 streams) and 50 feet (Category 4 streams). Restricting thinning activities to the outer edges of RHCAs will prevent adverse impacts to existing stream shading. Therefore, measurable increases in stream temperatures are not expected to result from proposed thinning activities. Less than 1% of RHCA in Alternatives 2, 2m, and 3 would be thinned (Table 12).

Table 12. Acres and percent of RHCA treated with commercial thinning

Alternative	Acres of commercial harvest within RHCAs	Acres if non-commercial thinning in RHCAs	Percent of RHCAs within project area treated
2	2	6	<1%
2m	2	33	<1%
3	1	0	<1%

Groundwater temperatures can also influence stream temperatures. Where groundwater is close to the surface, removal of the forest canopy may increase groundwater temperatures. Brosofske et al. (1997) showed a strong relationship between upland soil temperatures and stream temperatures for both preharvest and postharvest (clearcutting) conditions in their study area in western Washington. Soil temperatures following clearcutting can be up to 6°C warmer (Bhatti et al., 2000) and up to 1°C warmer in partial cuts (Brooks and Kyler-Snowman, 2008). Since timber harvest activities proposed under Alternative 2, 2m, and 3 are primarily commercial thinning, and not clear cutting, it is unlikely that an increase in soil temperature will occur. Thus, it is unlikely that an increase in stream temperatures will occur as a result of thinning in areas outside of RHCAs.

Mule Deer Treatment

In Alternative 2m, 27 acres of conifer thinning would occur on the east side of Eagle Creek to enhance mule deer fawning areas in units M1, M2 and M3. About half of the acres in unit M1, the largest meadow, are outside of the RHCA, all of unit M2 is within the RHCA, and most of unit M3 are within the RHCA. These 27 total acres are reflected in the acres of non-commercial thinning in RHCAs in Table 11, although some of the acres are in the meadow, but outside of the 300 feet RHCA buffer. Thinning would be done by hand. Lodgepole pine and grand fir under 9 inches dbh would be thinned. There would be no thinning within one site potential tree height of the stream. Trees that would be thinned range from 80 feet to over 300 feet away from Eagle Creek. Because of the no activity buffer within one site potential tree height of Eagle Creek, any reduction in stream shade that could affect solar radiation and stream temperature is expected to be eliminated.

Transportation System Improvements

Danger Tree Removal – Danger trees would be removed from haul road corridors for public and forest worker safety. Dangers trees in RHCAs would be felled and left on site in accordance with INFISH S&G TM-1. Felling of danger trees in RHCAs adjacent to perennial streams is not expected to result in a significant decrease in streamside shading.

Prescribed Fire Activities

For all alternatives, proposed burning activities will result in a low severity fire in RHCAs adjacent to perennial streams in the project area. This will be accomplished by burning when fuel moisture levels are high, not actively lighting fires in RHCAs, and allowing fires to back into RHCAs from adjacent upslope areas. These techniques result in low intensity fires that burn in a patchy distribution of burned and

unburned areas in RHCAs. Trees removed by prescribed fire in RHCAs will primarily be understory trees (≤ 8" dbh). Understory trees of this size typically do not provide significant levels of stream shading.

Riparian shrubs are not expected to be impacted as a result of the proposed burning because they are present in the moister riparian areas. Where the above ground portions of riparian shrubs are impacted by fire, they will likely sprout back relatively quickly because the low severity fire will not be hot enough to destroy root crowns.

The proposed burning in RHCAs adjacent to intermittent streams poses little risk of increasing stream temperatures because these streams are normally dry during the summer and fall months. Based on these factors, the Two Eagle Project is unlikely to result in a measurable increase in water temperature and a degradation of water quality in streams in the aquatic effects analysis area.

There would be no post-harvest prescribed burning, since there is very limited commercial or non-commercial treatments in RHCAs in any alternative. No hand piling and burn piles post commercial thinning activities would occur in RCHAs in any alternative.

No direct or indirect effects to stream temperature from prescribed burning are expected since only a minimal amount of understory RHCA would burn where prescribed fire backs into RHCAs.

D. Channel Stability and Function

Management actions can influence channel stability. When assessing stability and function of stream channels, a comprehensive assessment is necessary to determine cause and effect relationships when stability appears compromised. Changes in stability from natural levels can result from changes in water supply and/or sediment supply (Lange, 1955). Changes can also result from disturbances or influences at the channel level. Channel stability changes may result from livestock management, timber harvest, placer mining, road construction, and other disturbances within the stream corridor. For example, roads located within the stream migration zone may interfere with established patterns of sinuosity, causing a cascade of effects that ultimately result in decreased stability. When multiple management actions occur within a watershed, it becomes more difficult to assign cause and effect relationships with respect to channel stability. A decrease in channel stability usually results in loss of habitat values for aquatic life. These changes can be quantified through stream attributes including width/depth ratios, pool frequency and pool volumes.

Effects from timber harvest activity typically relate to increased water and/or sediment yields. ECA has been used in the past as a procedure representing a coarse-scale analysis to determine if sufficient cover removal at the watershed scale has occurred through harvest or fire to alter the flow regime (see Water Quantity section). If sediment yields have substantially increased due to harvest, fire and road systems, channel stability can decrease as the stream system receives more sediment than it can effectively transport. Because there are not recent clearcuts or stand replacing wildfires in the Two Eagle project area, the proposed commercial thinning and fuels reduction activities are not expected to increase water and sediment yields that could affect channel stability and function.

Measurement Indices: The Forest Plan RMO for channel stability is >80%. The analysis of alternatives will determine any changes in channel stability from the existing condition. The final determination will conclude whether channel stability will remain static, increase or decrease from existing condition.

Any effects of the alternatives are based on best professional judgment, considering the existing condition, changes in water and sediment regimes, and changes to the stream channel or riparian area. Direct effects occur at the time and place of the action. For channel stability, direct effects consider any actions within the channel system, such as construction of a stream crossing or road fill eroding into the channel. Indirect effects occur later in time or removed from the activity area. Indirect effects from timber harvest, fire and roads result from increased water and/or sediment yields within the Upper Eagle Creek,

West Eagle Creek, or Bennet Creek-Eagle Creek subwatersheds. A threshold of 15% ECA is used to determine whether increases in water yield might occur. Changes in fine sediment yield are associated with surface erosion occurring with timber harvest, prescribed burning, and roads. Changes in bedload sediment delivery are typically associated with severe gullying or mass failures, or decreased stream stability which results from increased water yields.

Alternative 1

There would no change in current management activities therefore current conditions would be maintained through the mid-term. An increase in the likelihood of an uncharacteristic wildfire event(s) is predicted for the project area in the long-term (see Fuels section). A wildfire event that occurs with sufficient scope and intensity to alter flow and sediment regimes could decrease channel stability. For example, a wildfire that removes 50% of the cover in Upper Eagle Creek subwatershed could increase peak flows and deliver more sediment to Eagle Creek. The result would likely decrease channel stability, especially in lower gradient (<4%) reaches. An increase in width/depth ratios, and decrease in pool frequency and pool volumes would likely occur concurrently. The probability of this occurrence is difficult to predict, as many factors come into play.

Alternatives 2, 2m and 3

All alternatives have similar levels of direct effects, resulting from culvert installations and removals. The culvert actions occur on small perennial, intermittent and ephemeral streams. Alternative 2, 2m, and 3 have 2 installations/removal actions, and two culvert replacements for watershed improvement. The length of channel directly affected is approximately the length of culvert, about 20 feet for each crossing. The effect from temporary culverts will last as long as the road is used for haul, likely less than 1 year. The culvert replacements would increase the size of the structures for fish passage and simulate the natural channel bed, stream energy and flow regime, having beneficial effects to water quality and aquatic habitat.

While short-term increases of fine sediment may occur from increased traffic due to hauling on some road segments that are currently closed and on roads that are opened, long-term fine sediment delivery is expected to decrease due to road improvements and decommissioning of roads within RHCAs. The effect of fine sediment on stream stability is limited, especially on relatively high gradient streams within the project area. While limited deposition may occur on low-gradient reaches, most fine sediment gets transported downstream. Fine sediment has a bigger effect on habitat quality by filling in interstitial spaces of stream substrate. Channel stability is much more sensitive to changes in bedload sediment. No change in bedload delivery is expected from any of the actions under any action alternative because no gullying or increase in mass failures is expected.

Wet meadow restoration in the riparian area of Eagle Creek by the Two Color guard station and 7755-075 spur road would improve water quality and fish habitat by decreasing erosion rates to Eagle Creek, stabilizing the downcut channel, and improving wetland function in all action alternatives.

Channel stability is generally good (>80%) for most streams within the project area. Exceptions include reaches of Eagle Creek where valley bottom widths exceed about 200 feet. These reaches tend to allow excessive bedload deposition which in turn results in channel braiding and lateral migration. Reaches w/ channel braiding and lateral migration often exhibit stability less than 80%. These reaches may interact with Forest Road 77 in places, causing substantial loss of road fill and surface. Delivery of road material to the stream system acts to exacerbate channel braiding and lateral migration.

The action alternatives are not expected to affect stream channel stability. This is due to no appreciable changes to any factors which affect channel stability. These factors include: streamflow regime, sediment

regime, and any management changes within the stream corridor (especially road location). Relocation of roads outside the stream corridor, especially on Eagle Creek, would be necessary to achieve a measurable change in stream channel stability/function.

Summary of effects to water quality, fish and aquatic habitat from Action Alternatives

Because the majority of vegetation treatments were designed around RHCA buffers and there is very limited thinning in RHCAs, and no mechanical entry into RHCAs in commercial and non-commercial harvest activities, there is little risk of fine sediment reaching stream channels adjacent to harvest units. The two acres of proposed RHCA commercial harvest in Alternatives 2 and 2m, may create slightly more potential for ground disturbance, than Alternative 3, which includes one unit of commercial harvest in RHCAs in unit 84. However, since equipment will stay on the road prism and tree removal would occur with near full suspension logging systems, there is not expected to be sediment entering streams as a result of tree removal in any alternative. There would not be a measureable difference in fine sediment levels between alternatives.

Another factor that contributes to the lack of measurable differences in fines sediment levels between the action alternatives is that only a portion of eroded soil would travel to stream channels (Walling, 1999). The difference between soil erosion and the amount of sediment that reaches streams is called the sediment delivery ratio (Mutua and Klik, 2006). Each watershed has a unique sediment delivery ratio based on watershed characteristics that influence its buffering capacity, however, it is generally inversely proportional to watershed size, i.e. the larger the watershed the lower the sediment delivery ratio (Walling, 1988).

There is also a time lag factor that influences sediment delivery ratios that make it unlikely that measureable differences in fine sediment levels between the alternatives will be detectable: 1) as soil is eroded a portion of it can become trapped in sediment sinks prior to reaching stream channels, 2) a portion of sediment that reaches stream channels can be trapped by channel features such as LWD, and 3) portions of trapped sediment in both uplands and stream channels can be remobilized at a later date. These factors can result in sediment delivery ratios that can be a fraction of the amount of soil that is eroded in a watershed and can create lag time between initial erosion and deposition in streams that make it difficult to effectively measure changes in fine sediment in streams in the analysis area based on the relative sameness of the two action alternatives.

Measurable increases in fine sediment are predicted as a result of installation and removal of temporary and permanent culverts. These increases are predicted to be short-term. Under all three altneratives, 2 culverts would be installed and removed on closed roads, one on a Category 1 stream and one on a Category 4 stream would occur. Two additional culverts on Category 1 Jim Creek and Category 1 Grove Creek would be replaced as part of watershed improvements and one culvert on upper Jim Creek, closed road 7700464 would be removed and the road would be gated. Measurable increases in fine sediment could last for up to 48 hours and then would be expected to return to background levels.

The summary of effects to water quality, fish and fish habitat include:

- There would be no direct ignition of prescribed fire within RHCAs in Alternative 2, 2m, or 3
- Commercial harvest units would have default INFISH RHCA buffer widths implemented as no activity stream buffers, with the exception of two acres in Alternatives 2 and 2m, and one acre in Alternative 3, where a select few trees reachable from main road prisms would be removed around cottonwood, western larch or ponderosa pine trees. A minimum 100 feet no activity buffer would remain untouched on fishbearing streams. No equipment would enter RHCAs.
- Alternative 2, 2m and 3 would have direct, short term effects to water quality and indirect effects to fish and aquatic habitat by installing and then removing 2 culverts on Category 1 and 4 streams, removing 1 culvert on a Category 1 stream and replacing 2 culverts on Category 1

streams.

- All Alternatives would decommission approximately 11.06 miles of open road, including 3.5 miles of road within RHCAs. This includes 2.65 miles in Category 1 RHCAs.

Effects to Forest Plan Riparian Management Objectives

Based on the analysis of effects to watershed processes and proposed activities, the analysis of effects to Forest Plan RMOs will focus on: 1) fine sediment, 2) water temperature, and 3) LWD and pool habitat.

Fine Sediment RMO

Ecological Importance of RMO

Composition of the stream substrate is an important feature of aquatic habitat. Cobble and gravel substrates provide habitat for a diverse assemblage of benthic macroinvertebrates as well as eggs and early life stages of numerous fish species. Macroinvertebrates represent a substantial portion of the diet available to various fish species, particularly stream dwelling salmonids.

Fine sediment in streams is a normal component of salmonid habitat; however, major disruptions of aquatic ecosystems occur when sediment levels substantially exceed natural levels. Filling of interstitial spaces (i.e. the gaps between rocks on the stream bottom) with fine sediment (particles < 2 mm in size) eliminates habitat for many macroinvertebrates. Fish eggs and early life stages can also be buried and smothered when interstitial spaces are embedded with fine sediment. Studies have shown that an increase in 1-3mm size sand from 20% to 30% can decrease emergent survival of salmonid species from 65% down to 40% (Phillips et al., 1975). Fine sediments are known to impact fry emergence and survival, and fine sediment (<6.5mm in size) levels above 40% can effectively eliminate salmonid populations and many macroinvertebrate species (Everest and Harr, 1982). Winter habitat for juvenile salmonids is also lost as interstitial spaces in cobble-sized and larger streambed material are embedded with fine sediment.

Increases in fine sediment can occur from both increased transport of fine sediment from upland areas and from destabilized stream banks. Increases can result from both episodic sources such as wildfires or from chronic sources such a native surface roads. Episodic sources normally result in short-term increases that return to pre-disturbance levels through natural recovery processes. Chronic sources can result in long-term changes of stream channels and aquatic habitat.

Standards and Guidelines

Forest Plan Standards & Guidelines

The Forest Plan (1990) standard and guideline for fine sediment is "Where natural stream characteristics permit...limiting fine inorganic sediment covering stream substrate to 15 percent…" (Wildlife S&G 1). Fine inorganic sediment is defined as sand and silty material less than 3.3 mm in size. The INFISH amendment (1995) did not include an RMO for fine sediment. The Forest Plan standard was modified in 1995 and 1998 as part of the ESA consultations for the Forest Plan to <20% fine sediment (particles <6.4mm in size) in spawning areas or < 30% embeddedness (NMFS 1995, 1998).

Effects

Alternative 1

Particle size survey data that the Forest Service has in the project area shows the majority of cross sections have excessively high percent fines (particle size less than 5.7mm over 20%) (Table 5). Current fine sediment levels would likely be maintained in the short-term because current management activities would continue. Management activities in the analysis area that are likely to be contributing to elevated fine sediment levels are livestock grazing and roads (Eagle Creek Watershed Analysis, 1997). The majority of road maintenance activities proposed under the Two Eagle Project could be implemented

under regular road maintenance (see discussion in Cumulative Effects Section). Installation and replacement of the culverts proposed in Alternative 2, 2m, and 3 would likely not occur in the short-term under Alternative 1.

The majority of the timbered stands in the project area would be represented by a fuel model that is likely to exhibit moderate fire severities in the case of a wildfire. These conditions increase the likelihood of a large-scale wildfire in the project area in the future (see Fuels Specialist Report). Wildfires typically result in increases in fine sediment for three to five years, depending on the wildfire severity (Neary et al., 2005). Adverse impacts to aquatic habitat would likely occur where fine sediment levels exceed the 20% threshold. These levels would likely decrease spawning success for redband trout, and a decrease in survival of juvenile redband may occur.

Alternatives 2, 2m and 3

As detailed in the Watershed Erosion and Sedimentation Section, short term measurable increases in fine sediment is predicted to occur as a result of proposed activities under Alternative 2, 2m and 3 related to stream crossings on forest roads. Timber harvest and prescribed burning activities are not expected to result in measurable or immeasurable increases in fine sediment to stream channels because no ground based equipment would be entering RHCAs. Road maintenance, road reconstruction, and installation of 2 temporary culverts on Category 1 and 4 streams, and removal of the upper culvert on Jim Creek, and replacements of culverts on Jim Creek and Grove Creek on the 7700000 road, will also contribute to short-term increases in fine sediment in the analysis area, which could have short term effects to water quality.

Under Alternative 2, 2m, and 3, culvert installation and removal on perennial fishbearing streams would likely impact aquatic habitat a minimum of 210 feet downstream of the channel at the road crossing. Measurable increases in fine sediment could last for up to 4 months or until the first high flow event. Disturbed areas would be seeded and erosion control BMPs would be met for these sites.

In all alternatives, the impacts to aquatic habitat would include short-term measureable increases in fine sediment as result of installing, removing, and replacing culverts. All action alternatives would result in a long-term improvement in aquatic habitat as a result of road improvements that will decrease overall erosion rates in the action area. All alternatives have potential for long term benefits to water quality and aquatic habitat by decommissioning 11.06 miles of road that are currently open, including 3.5 miles in RHCAs (2.65 within Category 1 fishbearing stream RHCAs).

Water Temperature RMO

Ecological Importance of RMO

Water temperature influences the metabolism, behavior, and health of fish and other aquatic organisms. Fish can survive water temperatures near the extremes of their suitable temperature ranges. However, growth is reduced at low temperatures because all metabolic processes are slowed. At the opposite extreme, growth is reduced at high temperatures because most or all energy from food must be used for maintenance needs. Fish are also more susceptible to diseases near the extremes of their suitable temperature ranges. A large range of temperature preferences for redband trout/rainbow trout has been reported in the literature, with substantial regional variability. In general, redband trout will occupy waterbodies with water temperatures from 55 to 64°F. Upper lethal temperature for redband trout is generally about 75°F.

Standards and Guidelines

Forest Plan Standards & Guidelines

The Forest Plan water temperature standards are to meet state water quality standards and prevent measurable increases in water temperature (1990 Forest Plan, 1995 INFISH Amendment), and maintain

maximum water temperatures below 64°F within migration and rearing habitat and below 60°F within spawning habitats (INFISH). The Forest Plan Watershed Standards and Guidelines are:

> **2. Water Quality Standards and BMP's.** Meet Water Quality Standards for waters of the States of Oregon (Oregon Administrative Rules (ORAs), Chapter 340-41) and Idaho through planning, application, and monitoring of Best Management Practices (BMP's) in conformance with the Clean Water Act, regulations, and federal guidance issued thereto.
>
> **7. Stream Temperatures.** Prevent measurable temperature increases in Class I Streams (less than a 0.5 degree Fahrenheit change). Temperature increases on stream management unit (SMU) Class II (and fishbearing Stream Management Unit Class III) streams will be limited to the criteria in State standards. Temperatures on other streams may be increased only to the extent that water quality goals on downstream, fish-bearing streams will still be met. Normally, stream shade management on Class III streams will differ little from treatment on Class II streams. (Note: Class 1 and II are the same as Category 1, Class III is the same as Category 2).

Oregon State Water Temperature Standards

In addition to meeting the Forest Plan standard, the Forest must meet Oregon water quality standards under the Clean Water Act. EPA approved new water quality standards for Oregon in March 2004. Streams in the aquatic effects are considered "salmon and trout rearing and migration habitat" for Oregon water temperature standards. For the analysis area for aquatic habitat and species, the following water temperature standard applies:

> Eagle Creek and Tributaries upstream of the East Fork Eagle Creek Confluence:
>
> (e) The seven-day-average maximum temperature of a stream identified as having bull trout spawning and juvenile rearing use on subbasin maps and tables set out in OAR 340-041-0260: Tables 260A and Figures 260A and may not exceed 12.0 degrees Celsius (53.6 degrees Fahrenheit);

Effects

Alternative 1

Existing water temperatures in the analysis area are not meeting the ODEQ standard for bull trout spawning and rearing. Bull trout do not currently occupy these waters, however these fish may experience thermal stress as a result of the high water temperatures in summer months if they did. Current water temperatures would be maintained in the short-term because current management activities would continue.

The majority of the timbered stands would be represented by a fuel model that is likely to exhibit moderate to high fire intensities and severities. These conditions increase the likelihood of a large-scale wildfire in the project area in the future (see Fuels Specialist Report). A wildfire in the area could elevate water temperatures for up to 10 years, depending on the wildfire severity (Dunham et al., 2007). If water temperatures exceeded 64^{o}F for an extended period of time as a result of wildfire, survival of redband trout would likely be reduced.

Alternatives 2, 2m and 3

Effects to aquatic habitat from water temperature increases are unlikely as a result of thinning and prescribed burning activities under the action alternatives. Approximately 8 acres of thinning activities would occur in RHCAs under Alternative 2, and 35 acres of thinning activities would occur in Alternative 2m. No acres of thinning would occur under Alternative 3. However, these activities would occur in the outer portions of RHCAs greater than 100 feet from Category 1 streams therefore stream shade is unlikely to be affected because site potential tree height would be maintained. Burning in RHCAs would be

limited to backing into RHCAS under conditions that limit the severity and intensity of burning. Mortality of trees in RHCAs that provide shade would be limited to understory trees. Therefore, prescribed burning in RHCAs is unlikely to result in a measureable increase in water temperatures.

LWD and Pool Habitat RMOs

Ecological Importance of RMOs

LWD plays an important role in forested stream reaches. LWD aids in dissipating stream energy, trapping sediment and formation of pools and associated aquatic habitat. LWD also provides hiding cover for aquatic organisms. LWD is one of the most important sources of habitat and cover for fish populations (MacDonald et al., 1991). LWD provides suitable habitat over a wide range of streamflows and climatic conditions. LWD, habitat complexity, and salmonid production have been found to be related (Bisson and Sedell, 1984; Sedell and Swanson, 1984). LWD also functions as important colonization sites for aquatic macroinvertebrates and their food sources (Harmon et al., 1986; Dudley and Anderson, 1982).

LWD is a major component of channel form in smaller streams (Bisson et al., 1987). LWD can influence channel meandering, bank stability, variability in channel width, and affect the form and stability of gravel bars (Lisle, 1986). Megahan (1982) suggested that decreased LWD can result in less sediment storage and increased sediment routing and yield at the outlet of a watershed.

Pool frequency is a gauge of aquatic habitat diversity, and is an indicator of the degree to which streams are capable of supporting a varied and complex community of fish species. Pools provide important habitat throughout all salmonid life stages (Bjorn and Reiser, 1991). Pools are important for providing rearing habitat for juvenile fish and cool water refugia areas for adult fish during periods of low flow and elevated temperatures. Pools slow the transport of nutrients and store them fostering food production. Pool tailouts provide optimal spawning areas for salmonids due to hydraulic gravel sorting and intergravel flow characteristics. Pools are persistent features of stream channels (Knighton, 1987). The presence and abundance of pools is an important indicator of aquatic habitat function (Sullivan et al. 1987)

Effects

Alternative 1

Alternative 1 would maintain current levels of LWD and pool habitat in the short-term because current management activities would continue. As noted earlier, fish habitat in the analysis area generally meets the RMO for LWD but does not meet INFISH RMO for pool habitat (Table 5). Current management activities are required to meet INFISH Standards and Guidelines that promote improvement and recovery of aquatic habitat. A gradual improvement in LWD and pool habitat will likely occur as riparian vegetation continues to develop and additional LWD is delivered to stream channels.

LWD in stream channels originate from both upslope and streamside zones (Naiman et al., 2000). Large-scale episodic events such as stand replacement fires (Harmon et al., 1986; Romme et al., 2011), landslides (Reeves et al., 2003), and the combination of the two events (Burton 2005) can supply large amounts of LWD that persists in stream channels for decades to centuries (Naiman et al., 2002). Since landslides are generally rare in the analysis area, the majority LWD reaching stream channels likely results from the streamside zone (Table 13).

Table 13. Delivery Mechanisms for LWD in the Two Eagle Project Area

LWD Delivery Zone	LWD Delivery Method	Frequency	Role in Analysis Area
Streamside	Streambank Erosion	Chronic / Episodic	Primary
	Wind Throw	Chronic / Episodic	Secondary
	Disease	Chronic / Episodic	Secondary
	Fire	Episodic	Rare

Upslope	Landslide	Episodic	Rare

The majority of the forest stands would be represented by a fuel model that is likely to exhibit moderate to high fire intensities and severities. These conditions increase the likelihood of a large-scale wildfire in the project area in the future (see Fuels Specialist Report). A wildfire in the area would likely result in an increase in LWD levels depending on the wildfire severity (Beschta et al., 2004; Karr et al., 2004; Swanson et al., 2010, Romme et al., 2011).

Alternatives 2 and 3

Timber Harvest Activities

Impacts to INFISH RMOs for LWD and pool frequencies are unlikely. Approximately 35 acres in RHCAs would be thinned under Alternative 2m, including 27 acres for mule deer habitat enhancement, 8 acres would occur in Alternative 2, and one acre would occur in Alternative 3. Thinning activities will not occur within 100 feet of Category 1 stream channels and no thinning is proposed in Category 2 or 4 RHCAs. Given that an average site potential tree in the project area is 80 to 100 feet in height, INFISH RHCA buffers should be sufficient to eliminate impacts to future LWD that originate from the streamside zone for Category1 and 2 streams.

Channel sinuosity and large roughness elements (e.g. boulders, tree roots, LWD, bedrock) create flow obstructions which result in the formation of pools. In general, pool habitat increases as LWD increases (Dollof and Warren, 2003; Montgomery et al., 1995). However, there does not appear to be a relationship between LWD and pool habitat in steeper streams (Montgomery et al., 1995) or in streams with low stream power (Jackson and Sturm, 2002). As noted earlier, the majority of streams in the analysis area are high gradient streams, including fish-bearing streams which have been surveyed (Table 5), which may reduce the pool forming function of LWD in the project area.

Restricting commercial non-commercial thinning activities to at least 100 feet for Category 1 streams should be sufficient to prevent removal of trees that have the potential to fall into stream channels as LWD and potentially create pool habitat.

Small tributaries, such as Category 4 streams, can also transport LWD to streams especially where debris flows occur (Naiman et al., 2000). However, debris flows do not appear to be a major process in the analysis area. The primary delivery area for LWD reaching Category 4 streams in the project area appears to be the streamside zone. No thinning activities are proposed in Category 4 RHCAs in any alternative.

Danger trees may be removed from haul road corridors for public and forest worker safety. Dangers trees in RHCAs will be felled and left on site in accordance with INFISH S&G TM-1.

Prescribed Burning Activities

Impacts to the LWD and pool frequency RMOs are unlikely. Proposed burning activities would not impact existing LWD or future LWD because the burn prescription will target consumption of material 3 inches and smaller. Fire intensities will not be high enough to consume trees or downed wood large enough to function as LWD (> 20" dbh) in stream channels. Therefore, burning activities would not result in a reduction of current or future levels of LWD or pool habitat under the action alternatives.

Additional Forest Plan RMOs

Bank Stability, Lower Bank Angle, and Width-to-Depth Ratio

Alternative 1

Alternative 1 would maintain current levels of bank stability, lower bank angle, and width-to-depth ratios in the short-term because current management activities would continue. As noted above, fish habitat in the analysis area meets the RMOs for bank stability, and about half meet the RMO for width-to-depth

ratios, however most streams are within the range for Rogen channel types (see Table 5). Data on lower bank angles has not been collected. Current management activities are required to meet INFISH Standards and Guideline that promote improvement and recovery of aquatic habitat.

Alternatives 2 and 3

Timber Harvest Activities

Impacts to channel morphology RMOs (i.e. bank stability, lower bank angle, and width-to-depth ratio) will not occur because activities that could result in mechanical bank disturbance will not occur adjacent to Category 1 streams under the action alternatives. Approximately 35 acres in RHCAs would be included in commercial and non-commercial thinning units under Alternative 2m, 8 acres in Alternative 2, and one acre in Alternative 3. No equipment would enter RHCAs within treatment units in any alternative. No damage to streambanks within commercial and non-commercial thinning units is expected.

Prescribed Burning Activities

Impacts to the other INFISH RMOs (i.e. bank stability, lower bank angle, and width-to-depth ratio) are unlikely. Low intensity prescribed fire would be allowed to back into the outer edges of RHCAs in natural fuels burn block units; burning is not expected to encroach on streambanks or to burn vegetation that is stabilizing streambanks.

Cumulative Effects

Assumptions and Methodology

The cumulative effects analysis area for aquatic resources is the same as the analysis areas used for the direct and indirect effects analysis to watershed process and aquatic habitat. Potential cumulative effects are analyzed by considering the proposed activities in the context of present and reasonably foreseeable future actions. Reasonably foreseeable future actions are defined as within the next 5 years. Refer to Appendix D of the Two Eagle Project EA for a list of projects and activities occurring in the analysis area that were considered for cumulative effects to water quality, fish, and aquatic habitat.

Only activities that pose a risk of cumulative effects (adverse or beneficial) are discussed. The risks of cumulative effects with the effects of activities proposed under the action alternatives for the Two Eagle Project occurring are rated as:

- Low – insignificant or discountable cumulative effects on aquatic habitat may occur. Insignificant effects are defined as effects that a person, based on professional judgment, would not be able to meaningfully measure, detect, or evaluate. Discountable effects are those that are extremely unlikely to occur.
- Moderate – insignificant cumulative effects on aquatic habitat are likely to occur. A moderate rating assumes potential effects on habitat. The level of effects will not result in measureable changes in survival rates or population levels of aquatic species with special management status (i.e. ESA-listed, MIS, or Sensitive).
- High – measureable cumulative effects on aquatic habitat are likely to occur. Measurable effects are likely to result in changes in survival rates and population levels of aquatic species with special management status (i.e. ESA-listed, MIS, or Sensitive). A high rating assumes obvious adverse effects on habitat and aquatic species with special management status.

Current stream and riparian conditions reflect past activities which have occurred within the project area. The Eagle Creek Watershed Analysis- (1997) provides information on activities that have occurred in the analysis area.

Present and reasonably foreseeable future activities within the project area are identified in Appendix D of the EA.

Table 14. Summary of known present and reasonably foreseeable actions with a risk of cumulative effect on aquatic habitat and species.

Project	Potential Effects	Overlap in:		Measurable Cumulative Effect/Risk	Effects
		Time	Space		
Noxious Weed Management W-W Invasive Species Treatment ROD		Yes	Yes	No/Low	Weed treatments within RHCAs pose a risk to aquatic habitat and species and BMPs are used to minimize potential effects. Mitigation measures that include type of chemical treatments (using only herbicides that are labeled for use adjacent to aquatic areas), application rates, area treated, timing, and buffers on streams significantly reduce the risk of effects from this activity. Therefore, ongoing noxious weed treatment activities are rated as having a low risk of cumulative effects with the activities proposed under the action alternatives for the Two Eagle Project on watershed processes, and aquatic species and their habitat.
Veg Management		No	No	No/Low	Road improvements, road decommissioning and LWD additions proposed in Two Eagle are expected to result in incremental improvement in watershed processes and aquatic habitat.
Fuels Reduction & Rx Burning		Yes	Yes	No/Low	No pile burning would occur in RHCAs, therefore low risk of increases in erosion rates due Natural fuels burn blocks would allow low intensity fire to back into the outer edges of RHCAs.
Special Uses: • Phillips-Ingle Ditch		Yes	Yes	No/Low	The Phillips Ditch and diversion diversion located on West Eagle Creek are within the project area. The diversion captures nearly 100% flow of West Eagle Creek during the irrigation season and delivers it to farm and ranchland in the Keating Valley. As a result, flows in lower West Eagle Creek are reduced by at least 75% during late summer. The ditch also captures all tributaries along its length. The loss of water to West Eagle Creek results in a significant reduction in aquatic habitat for redband trout and other

Project	Potential Effects	Overlap in:		Measurable Cumulative Effect/Risk	Effects
		Time	Space		
					aquatic species. Water withdrawals also may be a contributing factor for high water temperatures (see Beschta, 1997). Grove Creek is illegally diverted upstream so that it artificially enters West Eagle upstream of the point of diversion and is diverted into the ditch. Proposed thinning and burning activities would not result in an increase in ECA in the project area, therefore it is unlikely that the proposed activities will result in changes in water yield or streamflows. Short-term measurable increases in fine sediment would occur as a result of culvert replacement activities. There is a low risk of cumulative effects with the diversion of irrigation water in the analysis area. Water withdrawals also may be a contributing factor for high water temperatures in Creek during low flows when water is diverted. However, direct/indirect effects to aquatic habitat from activities proposed under the action alternatives for the Two Eagle Vegetation Management are limited to short-term immeasurable increases in fine sediment and water temperature. ECA would not exceed 15%; therefore, water yield and streamflow are unlikely to be affected by proposed activities.
Recreation – Eagle Creek Wild & Scenic River		Yes	Yes	No/Low	
Recreation- Dispersed Camping		Yes	Yes	No/Low	Dispersed camp sites are located adjacent to fish-bearing streams. Dispersed camp sites adjacent to streams are a source of fine sediment and camp wood cutting can reduce future LWD to stream channels. Closing and blocking road 075 off of the 7755000, and user made trail (T24) off of the 7700000 would have beneficial effects to water quality and fish and aquatic habitat by blocking motorized use and causing erosion and

Project	Potential Effects	Overlap in:		Measurable Cumulative Effect/Risk	Effects
		Time	Space		
					sediment entering Eagle Creek.
Recreation- Snowmobile Trails		Yes	Yes	No	
Recreation -Firewood Cutting		Yes	Yes	No/Low	Harvest of these products is not permitted in administratively prohibited areas such as developed campgrounds or within 100 feet of wet areas, seeps springs, bogs, and standing or flowing water. No trees are permitted to be cut within 300 feet of perennial fish-bearing streams. Compliance with these regulations is monitored by USFS Special Forest Product Coordinators and Law Enforcement Officers.
Recreation – OHV Use		Yes	Yes		See travel management
Recreation – Lilly White Guard Station		Yes	No	No	
Roads & Trails – Travel Management Plan		Yes	Yes	Yes/Low	Not detectable at subwatershed scale, the Wallowa-Whitman Travel Management Plan is planned for completion within the next 5 years. OHV use will be regulated and will prevent or minimize direct and indirect effects to water quality and fisheries resources resulting in beneficial effects. Road management in the Two Eagle project in combination with the travel management plan may result in a decrease in fine sediment levels. Cumulative effects would have an overall benefit on water quality and aquatic habitat.
Road Maintenance – 7700 road		Yes	Yes	Yes/ Moderate	The short-term effects from road maintenance activities are minimized by following INFISH standards and guidelines, and road maintenance BMPs. In the long-term, road maintenance activities reduce adverse effects to aquatic habitat by reducing overall erosion rates on the road system. Culvert installations, removal and replacement would have the greatest short term direct effect on water quality and fish habitat.
Roads – Danger Tree		Yes	Yes	No/Low	Danger trees within RHCAs

Project	Potential Effects	Overlap in:		Measurable Cumulative Effect/Risk	Effects
		Time	Space		
Removal					are cut but left on site.
Grazing Allotments	Potential damage to riparian areas and water quality.	Yes	Yes	Yes/ moderate	Harvest, fuels reduction work, and prescribed burning has the potential to make areas not previously accessible to cattle accessible; however, there is such limited entry into RHCAs, that this is not expected to increase potential for impacts to riparian areas and water quality from grazing. INFISH S&Gs and WWNF utilization levels minimize cattle impacts to aquatic habitat.
Wildlife Enhancement – Eagle Creek Cooperative Closure Area		Yes	Yes	No	
Mining		No	No	No	No approved plans of operation
Private Land Activities • Private Structures • 3 Year round Residences		Yes	Yes	No/Low	Erosion rates from logged areas on private lands likely increased during and after logging activities. Impacts from these timber sales have likely abated since majority of the harvest activities occurred around 11 years ago.

Alternative 1

Alternative 1 would maintain current management activities therefore no additional cumulative effects to aquatic habitat would occur over within the reasonably foreseeable future, five years. Current watershed processes (water yield and streamflow, erosion and sedimentation, channel stability/function) would be maintained. The existing condition of aquatic habitat in the project area reflects the impacts of past management activities in the project area (See Aquatic Habitat Section). Improvements in the LWD and pool habitat elements will likely occur over the long term (>10 years) as a result of changes in management activities resulting from the adoption of the INFISH Forest Plan Amendment (1995). The INFISH Forest Plan Amendment modified management activities to reduce impacts to aquatic habitat and to accelerate the recovery rate of aquatic habitat (INFISH, 1995). Pool habitat and LWD levels are likely lower than prior to the start of intensive timber harvest activities in the analysis area. Past vegetation management activities in the project area include 34 timber sales (green and salvage) from 1954 through 2003. Of the 34 timber sales, only six of the sales have occurred since 1995, when the Forest Plan was amended by INFISH. While specific habitat data is not available for the project area, trends in LWD and pool habitat in the project area likely mirror trends for LWD and pool habitat that have occurred in the Pacific Northwest and adjacent areas. Bilby and Ward (1991) found a significant decrease in LWD in managed streams compared to old-growth streams. McIntosh et al. (1994) and Quigley et al. (1997) documented a general decline pool habitat since the 1930's in streams in the Columbia Basin.

Alternatives 2 and 3

Past and current management activities have had and are having impacts to aquatic habitat and aquatic species in the Two Eagle aquatic analysis area. These impacts have been incorporated into the existing condition description and have likely resulted in a decline in aquatic and riparian habitats in the analysis area compared to the period prior to intensive management activities. Water temperatures, erosion rates and fine sediment levels in the project area are likely higher today then prior to European settlement. Current activities (including livestock grazing and road maintenance activities) on Forest Service lands are managed under the standards and guidelines of INFISH which were developed to speed the recovery of riparian and aquatic habitats.

Sediment produced from the Two Eagle Project would combine with sediment produced from other activities including recreation, grazing, logging, roads, fire and private land activities. There would be a short-term increase in sediment production associated with project implementation moderated by effective BMP practices and mitigation measures. A long-term decrease in sediment is expected as a result of road reconstruction and maintenance and fire risk reduction, decreasing cumulative effects.

No measureable change in channel stability/function is expected under any action alternative. This is because present and reasonably foreseeable future actions are not predicted to appreciably resolve the negative human-caused influences on channel stability. The biggest contribution to stream instability within the cumulative effects analysis areas is the placement of roads within the stream migration corridor. These roads inhibit streams to exhibit the pattern and profile that would naturally occur in certain reaches of Eagle Creek and West Eagle Creek. There is no plan to remove and/or relocate these roads.

Livestock grazing and road maintenance activities in the project area are rated as a moderate risk for negative cumulative effects with the activities proposed under the action alternatives for the Two Eagle Project on aquatic species and their habitat. This risk rating is based on the likelihood that immeasurable increases in fine sediment are likely to occur from the two activities that would be additive to potential immeasurable increases in fine sediment resulting from proposed activities for the Two Eagle Project.

Measureable increases in fine sediment in aquatic habitat in the vicinity of culvert installation, removal, and replacement on Jim Creek and Grove Creek and tributary to West Eagle Creek, would cause a short

term increase in sediment. However, the predicted increases are likely to be limited in both area (extend less than 0.125 miles downstream of each site) and duration (dissipating during runoff the following spring). Thus it is unlikely that ongoing grazing or road maintenance activities will result in an additional measureable cumulative increase in fine sediment levels in the vicinity of the culvert sites. Therefore there is a moderate risk of negative cumulative effects associated with these activities (Table 13). The risks of cumulative effects from other activities are rated as low (Table 13) and will not be discussed further in this analysis.

Road Work

Road improvements and road decommissioning proposed under the Two Eagle project would likely result in an overall decrease in erosion rates in the project area and a decrease in fine sediment levels in streams in the analysis area where roads are contributing sediment. These activities would result in an incremental improvement of impaired watershed processes and aquatic habitat conditions in the project area that have resulted from pre-INFISH timber sale activities. Therefore, activities proposed under the action alternatives for the Two Eagle Project are rated as having a moderate risk of positive cumulative effects on watershed processes, and aquatic species and their habitat.

Regularly scheduled road maintenance occurs every one to seven years depending on the condition of the road, the assigned maintenance level, and the maintenance priority. Other scheduled maintenance activities occur as specific needs are identified. Maintenance levels for roads are determined by the road management objectives, the intended use, operational requirements, and budget levels. Maintenance activities occur primarily from late April to late November depending on the actual condition of the road and moisture level. Maintenance levels are summarized in the following paragraphs.

Three types of road surface occur in the project area: (1) native (i.e. dirt surface), (2) improved (i.e. pit-run surface, spot-rocked), and (3) aggregate (i.e. crushed rock surface). The surface types vary for each maintenance level of road depending on the long-term objectives for the road.

Level 1 road maintenance occurs on roads closed to vehicle traffic and reoccurs on at least a seven year rotation to protect adjacent resources such as soil, water, and fisheries. Roads and associated ditches are rehabilitated through natural re-vegetation and artificial seeding processes. Native species of grasses and forbs are seeded on selected areas. Maintaining drainage facilities and runoff patterns is emphasized. These roads may be reopened in the future to support management activities under a separate decision and analysis.

Level 1 road maintenance occurs in two steps. The first step blocks and disguises the entrance to close the road. Drainage structures, such as waterbars, are installed to minimize soil erosion. The second step involves annual inspection of the road closure method and maintenance of the drainage structures as needed. Culverts and waterbars are cleaned by hand since the road is closed to standard width vehicles and equipment.

Level 2 road maintenance occurs on open roads managed for use by high-clearance vehicles. Level 2 maintenance recurs on a three to seven year rotation to protect adjacent resources such as soil, water, and fisheries. Level 2 maintenance entails cleaning culverts, maintaining or cutting water bars and drainage dips, outsloping road surfaces, grass seeding the entire road and ditch surfaces, and replacing culverts where needed.

Level 3, 4, and 5 road maintenance occurs on open roads managed for use by low-clearance vehicles. Level 3, 4, and 5 maintenance recurs annually to protect adjacent resources such as soil, water, and fisheries. The difference between Levels 3, 4, and 5 depends on the degree of user comfort and convenience, surface types and treatments, and traffic management strategies. Level 3, 4, and 5 roads provide for long-term use and administration of National Forest System activities.

Typical treatments for Level 3, 4, and 5 roads include patching pavement; chip sealing worn pavement surfaces; grading and/or replacing crushed aggregate surfaces; dust abatement on aggregate surfaces; creating drainage dips; maintaining and cleaning debris from water bars, drainage ditches, and culverts; seeding cut and fill slopes; trimming roadside brush; and felling incidental trees that pose hazards to passing motorists.

Road maintenance practices can vary to provide additional protection to soil and water resources. Seeding of closed roads and low-use roads may be intensified. Keeping maintenance equipment away from streams and wet areas and limiting the number of stream crossings may be emphasized to protect soil and water resources. The use of pit-run (3 to 6 inches) rock on roadbeds may be used to increase protection from erosion. Emergency repair of roads may occur after natural disasters such as flash floods or unusually high spring runoff for all maintenance levels.

Road maintenance is an ongoing activity. Main gravel roads (such as FR 77, FR 67) usually receive surface maintenance once a year. On about a 5-year schedule, all other roads get inspected for deferred maintenance. Problems identified during inspections are taken care of within the year.

The short-term effects from road maintenance activities are minimized by following INFISH standards and guidelines, and road maintenance BMPs. In the long-term, road maintenance activities reduce adverse effects to aquatic habitat by reducing overall erosion rates from the road system. A short-term increase in erosion rates and an immeasurable increase in fine sediment are predicted to occur as a result of the action alternatives for the Two Eagle Project. Therefore, ongoing road maintenance activities are rated as having a moderate risk of negative cumulative effects with the activities proposed under the action alternatives for the Two Eagle Project on watershed processes, and aquatic species and their habitat.

Grazing Allotments

The analysis area for aquatic resources for the Two Eagle Project includes portions of three grazing allotments; all of which are active allotments (Table 15). Currently the majority of riparian areas in the project area are open to grazing. Majority of streams in the analysis area are Rosgen B channels that are resilient to impacts from livestock grazing. B channels are characterized by stable streambanks and are relatively insensitive to disturbance (Rosgen, 1996). Low gradient stream reaches (Rosgen C channels) are very sensitive to disturbance including grazing.

Impacts to riparian and stream habitat from grazing were identified in the Eagle Creek Watershed Analysis (1997). Grazing was identified as a cause for unstable streambanks in the analysis area. Areas where impacts were the greatest were characterized by low gradient stream reaches adjacent to roads (Eagle Creek Watershed Analysis, 1997).

Table 15. Range Allotments in the Two Eagle Project Area

Allotment Name	National Forest Acres in project area	Livestock Numbers (Cow/Calf)	Dates of Use	Type of Permit	Grazing System
Big Creek	4416	539	6/16-10/15	Term	Deferred rotation
Goose Creek	1306	495	6/1-10/30	Term	Deferred rotation

PACFISH/INFISH grazing guidelines (Enclosure B: Recommended Livestock Grazing Guidelines Rev. 7/31/95; commonly referred to as “Enclosure B”) state that the “Influences of grazing must result in riparian restoration at a minimum of near natural rates.” This same reference, describes achieving a “near natural rate of recovery”, in general, as avoiding effects that “carry over to the next year” so as to prevent the likelihood of cumulative, negative effects. In response to Enclosure B, the WWNF developed condition thresholds for utilization for herbaceous vegetation and shrubs (Enclosure: PACFISH/INFISH W-W Interpretations Pertaining to Livestock Management Activities [dated May 1996]). By not exceeding these utilization levels a near natural rate of recovery should be achieved.

Implementation monitoring indicates that Forest Plan utilization standards are being met most years on the active allotments (personal communication Kelby Witherspoon, Whitman RD, Aric Johnson La Grande RD). There are areas where grazing impacts to streams have been identified in the analysis area and legacy effects from past grazing activities still evident; however, based on monitoring results, the current management strategy has generally been successful in allowing for the near natural rate of recovery of riparian/aquatic habitat components as required by INFISH GM-1. Therefore, ongoing grazing activities are rated as having a **moderate risk** of negative cumulative effects with the activities proposed under the action alternatives for the Two Eagle Project on watershed processes, and aquatic species and their habitat.

Global Climate Change

Global climate change has the potential to have impacts to aquatic habitat through increases in water temperature and changes in streamflows. The ability to maintain existing high quality habitats and to restore degraded habitat will be influenced by climate change over the next several decades with projected higher average air temperatures, more winter precipitation falling as rain versus snow, and diminishing wither snow packs resulting in earlier snowmelt. High levels of watershed resiliency is critical for offsetting potential impacts of climate change. Predicted effects of climate change in the Blue Mountain include:

- Less snowpack and more precipitation as rain in the wet season. This is expected to increase the probability of rain-on-snow events, reduce summer baseflows, and increase the frequency of large flood events (Halofsky and Peterson, 2016).
- Warmer hotter summers. This is expected to increase competition for water resources in the uplands during the summer, increase frequency of wildfire, and alter potential vegetation groups across the forest by 2080 (Halofsky and Peterson, 2016).

Although options for forest managers to minimize the harm to aquatic resources from climate change are limited, there are several management actions that can help protect salmon and trout:

- Minimize anthropogenic increases in water temperature by maintaining well-shaded riparian areas.
- Maintain a forest stand structure that retains snow, reduces the "rain on snow" effect associated with forest openings, and promotes fog drip.
- Disconnect road drainage from the stream network to soften discharge peaks during heavy rainstorms.
- Ensure that fish have access to seasonal habitats, e.g., off-channel wintering areas or summer thermal refugia.
- Protect springs and large groundwater seeps from development and water removal, as these subterranean water sources will become increasingly important when surface flows are altered by climate change (Bisson, 2008).

Potential Impacts to Aquatic Habitat in the Analysis Area from Global Climate Change

Based on the above information, long-term changes to aquatic habitat in the analysis may occur as a result of global climate. These changes may include:

- Increases in water temperatures in response to increases in air temperature,
- Changes in runoff patterns in response to an increase in the amount of winter precipitation that falls as rain:

- Decreases in summer streamflows in response to a reduction in snowpack.
- Reduced duration of spring runoff but higher peak flows due to an increase the amount of winter precipitation that falls as rain
- Activities proposed under Alternatives 2 and 3 are unlikely to have measureable cumulative effects with global climate change because:
    - The proposed thinning activities are unlikely to result in a change in runoff patterns because a significant decrease in forested cover would not occur.
    - Potential increases in water temperature as a result of proposed burning are unlikely to occur in the analysis area and if increases do occur they are unlikely to be measureable.

No reduction in stream shade is expected to result from prescribed burning or commercial/non-commercial thinning in Alternatives 2, 2m and 3 and commercial thinning activities in Alternative 2. Reduction in shade is not likely to result in a measureable increase in stream temperatures in the analysis area since thinning activities are minimal and are beyond one site potential tree height. Therefore, climate change is rated as having a low risk of negative cumulative effects with the activities proposed under the action alternatives for the Two Eagle Project on watershed processes, and aquatic species and their habitat.

Aquatic Management Indicator Species

The WWNF Forest Plan identifies two fish species as Management Indicator Species (MIS). These include the redband /rainbow trout and steelhead (USDA 1990). These species were selected as they were considered to be good indicators of the maintenance and quality of instream habitats. These habitats were identified as high quality water and fishery habitat.

The NFMA regulations require that "fish and wildlife habitat be managed to maintain viable populations of existing …species in the planning area." To ensure that these viable populations are maintained, the Pacific Northwest Region of the Forest Service has identified management requirements for a number species within the region. These Management Indicator Species are emphasized either because of their status under ESA or because their populations can be used as an indicator of the health of a specific type of habitat (USDA 1990).

Riparian ecosystems occur at the margins of standing and flowing water, including intermittent stream channels, ephemeral ponds, and wetlands. The aquatic MIS were selected to indicate healthy stream and riparian ecosystems across the landscape. Attributes of a healthy aquatic ecosystem includes: cold and clean water; clean channel substrates; stable streambanks; healthy streamside vegetation; complex channel habitat created by large wood, cobles, boulders, streamside vegetation, and undercut banks; deep pools; and waterways free of barriers. Healthy riparian areas maintain adequate temperature regulation, nutrient cycles, natural erosion rates, and provide for instream wood recruitment.

The fish bearing streams or portions of fish bearing streams in the project area that have MIS species include:

Eagle Creek

West Eagle Creek

Jim Creek

Basin Creek

Trout Creek

Grove Creek

Two Color Creek

MIS Selection

The following aquatic MIS species have been documented in the analysis area: redband trout. Redband trout are widely distributed across the WWNF occupying streams in both anadromous and non-anadromous stream systems. MIS species are indicators of riparian and aquatic habitat health. Monitoring for these MIS species consists of field inventory of stream conditions (USDA 1990). Current inventory methods for stream and riparian conditions include: stream surveys, Properly Functioning Condition (PFC) assessments, pebble counts, and Multiple Indicator Monitoring (MIMs).

Redband Trout (Wallowa-Whitman NF Management Indicator Species)

Redband trout, the resident form of *Oncorhynchus mykiss*, are a WWNF management indicator species. Redband trout in the project area likely shared a common gene pool with Snake River steelhead prior to the construction of the Hells Canyon Dam Complex (Hells Canyon, Oxbow, and Brownlee dams). Redband trout are widely distributed in the project area and occupy all Category 1 streams.

Life History

Redband trout are sensitive to changes in water quality and habitat. Adult redband trout are generally associated with pool habitats, although various life stages require a wide array of habitats for rearing, hiding, feeding, and resting. Pool habitat functions as important refugia during low water periods. An increase in sediment lowers spawning success and reduces the quantity and quality of pool and interstitial habitat. Other important habitat features include healthy riparian vegetation, undercut banks and LWD.

Spawning takes place from March through May. Redband redds tend to be located where velocity, depth and bottom configuration induce water flow through the stream substrate, generally in gravels at the tailout area of pools. Eggs incubate during the spring and emergence occurs from June through July depending on water temperatures. Redband trout may reside in their natal stream or may migrate to other streams within a watershed to rear.

Abundance in Analysis Area

Abundance surveys for redband trout have not occurred in the Eagle Creek system. The analysis area provides about 6.2% of the total habitat for redband trout on the WWNF (Table 16).

Table 16. MIS distribution in the analysis area in relation to the Wallowa-Whitman National Forest range

Aquatic/Riparian MIS	Forest Distribution (mi)*	MIS in Analysis Area (mi)	Proportion of MIS habitat in Project Area out of total on Forest
Rainbow Trout/ Redband Trout	320	19.8	6.2%

*Miles calculated for the Wallowa-Whitman National Forest.

Project Relationship to Forest Plan

Forest Plan Habitat Desired Conditions/Objectives: “Riparian health will be maintained or enhanced through more stringent livestock management requirements to the benefit of wildlife and salmonid fishes.” (WWNF Forest Plan Chap 4, p 13).

The WWNF Forest Plan was amended in 1995 by the direction of the Regional Forester with the Interim Strategy for Managing Inland Native Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (INFISH). The goals of INFISH establish an expectation of the characteristics of healthy, functioning watersheds, riparian area, and associated fish habitat. Riparian management objectives (RMOs) were developed under INFISH to describe good habitat for inland native salmonids. Data from Level II stream surveys are used to compare existing stream habitat conditions to Forest Plan RMOs. The WWNF uses default RMOs from the INFISH amendment rather than developing watershed specific RMOs. These default RMOs were developed from extensive Pacific Northwest and

Intermountain (now Rocky Mountain) Research stations data collected in Oregon and Washington and stream inventory data collected by BLM and USFS units. The default RMOs were also developed prior to research that linked stream channel morphology to stream channel features such as pool spacing and width to depth ratios.

Streambank Stability: Stable streambanks are an important component of streams and aquatic habitat. Stable streambanks reduce the likelihood of excessive streambank erosion and channel migration. Stable streambanks also result in the creation of undercut streambanks in certain stream channel types (i.e. Rosgen E and C channel types) that provide important habitat for salmonids. The INFISH Forest Plan amendment (1995) established an RMO for bank stability for streambanks to be >80% stable. The INFISH RMO was modified in 1995 and 1998 for streambanks to be >90% stable as part of the ESA consultations for the Forest Plan (NMFS 1995, 1998).

Fine Sediment: The INFISH amendment (1995) did not include an RMO for fine sediment. As a result of ESA consultation for Forest Plans in the range of Snake River (SR) Chinook salmon (1995) and SR steelhead (1998) an RMO was developed for fine sediment. The RMO is <20% fine sediment (particles <6.8mm in size) in spawning areas or <30% embeddedness in rearing areas as part of the ESA consultations for the Forest Plan (NMFS 1995, 1998).

Pools per Mile: The INFISH RMO (pools/mile) is based on wetted stream width (Table 17).

Table 17. INFISH RMO for pool habitat.

Stream Wetted Width (feet)									
Number of Pools per Mile	10	20	25	50	75	100	125	150	200
	96	56	47	26	23	18	14	12	9

LWD per Mile: The INFISH RMO for streams east of the Cascade crest is greater than 20 pieces per mile; with piece size greater than 12" in diameter and greater than 35' in length.

Wetted Width-to-Depth Ratio: The INFISH Forest Plan amendment (1995) established an RMO for width-to-depth ratio of <10.

Water Temperature: The Forest Plan water temperature RMO directs the Forest to meet state water quality standards and prevent measurable increases in water temperature (1995 INFISH Water Temperature RMO), and maintain maximum water temperatures below 64°F within migration and rearing habitat and below 60°F within spawning habitats (INFISH).

Standards and Guidelines for Aquatic MIS Habitat

- Watershed Standard and Guideline 6: Timber Management. Harvest will not occur, on a scheduled basis, within 100 feet of the high water line on either side of Class I and II streams (Category 1). ***Under the action alternatives for the Two Eagle Project, timber harvest will not occur within 100 ft of Class I and II streams (Category 1 streams).***
- Watershed Standard and Guideline 7: Stream Temperatures. Prevent measurable temperature increases in Class I streams (less than a 0.5 degree Fahrenheit change). Temperature increase on SMU Class II (and fish bearing SMU Class III) streams will be limited to the criteria in State standards. ***Under the action alternatives for the Two Eagle Project, timber harvest and thinning activities will not occur within 100 ft of Class I and II (Category 1) streams therefore no measurable changes in water temperature are likely. Prescribed burning activities and commercial thinning would not result in the loss of shading and therefore no measureable change in water temperatures would occur.***
- Watershed Standard and Guideline 8: Channel Stability. Maintain natural LWD, plus trees needed for a future supply, to protect or enhance stream channel and bank structure, enhance water

quality, and provide structural fish habitat in all SMU classes. ***Under the action alternatives for the Two Eagle Project, only extremely limited commercial and non-commercial harvest and thinning activities will occur in RHCAs to meet silvicultural objectives for opening stands to encourage cottonwood growth (see Silviculture Report) in Alternatives 2 and 2m, and to enhance mule deer habitat in Alternative 2m. No effect on future wood recruitment is expected because of the no activity buffers and limited entry into the outer edges of RHCAs on a select few acres. No effect on future wood supply that would fall into the channel is expected. Channels and streambanks will be protected and maintained and water quality and structural fish habitat would be maintained.***

- INFISH TM-1: Prohibit timber harvest, including fuelwood cutting, in RHCAs except: (b) Apply silvicultural practices for RHCAs to acquire desired vegetation characteristics where needed to attain RMOs. Apply silvicultural practices in a manner that does not retard the attainment of RMOs and that avoid adverse effects on inland native fish. ***In Alternative 2 and 2m, commercial and non-commercial harvest would occur in RHCAs in 8 acres to improving condition of existing cottonwood stands. In Alternative 3, one acre of commercial thinning would occur in RHCA. Thinning will not occur within 100 feet of Category 1 streams and no thinning would occur within Category 2 stream RHCAs. The one acre in unit 84 is considered Category 4 RHCA, it is a wetland/wet area less than 1 acre in size. (See discussions in Aquatic Habitat Section, Fine Sediment RMO, Stream Temperature RMO, and LWD/Pool Habitat RMOs).***
- INFISH RF-2b: For each existing or planned road, meet the RMOs and avoid adverse effects to inland native fish by minimizing road and landing locations in RHCAs. ***Under the action alternatives for the Two Eagle Project, no skid trails and or landings will occur RHCAs. No mechanical entry into RHCAs is proposed under any alternative. This will avoid disturbed soil conditions in RHCAs.***
- INFISH RF-3a & b: a) reconstructing road and drainage features that do not meet design criteria or operation and maintenance standards, or that have been shown to be less effective than designed for controlling sediment delivery, or retard attainment of RMOs, or do not protect priority watersheds from increased sedimentation; b) prioritizing reconstruction based on the current and potential damage to inland native fish and their priority watersheds, the ecological value of the riparian resources affected, and the feasibility of options such as helicopter logging and road relocation out of RHCAs. ***Under the action alternatives for the Two Eagle Project, roads that will be used for proposed vegetation management activities will have drainage problems repaired and will be brought up to standards prior to haul.***
- INFISH FM-1: Design fuel treatment and fire suppression strategies, practices, and actions so as not to prevent attainment of RMOs, and to minimize disturbance of riparian ground cover and vegetation. ***Under the action alternatives for the Two Eagle project, fire severity will be limited to a low fire severity that could back into the outer edges of RHCAs. Burning would occur when fuel moisture levels are high, there would not be active lighting in RHCAs, only fire backing into RHCAs from adjacent areas.***
- INFISH FM-4: Design prescribed burn projects and prescriptions to contribute to the attainment of RMOs. ***Under the action alternatives for the Two Eagle Project, the burn prescription for Two Eagle will result in a low intensity burn within RHCAs.***

Project-level MIS Effects Analysis

Fish habitat in the analysis area generally does not meet INFISH RMOs for pool habitat and about half of the channels surveyed meet the width-to-depth ratio (Table 5). However, the INFISH RMO for width-to-

depth was developed prior to advances in our understandings of the relationship between width-to-depth ratios and natural channel forms (Rosgen 1996). Normal ranges for width-to-depth ratios (bankfull width) for Rosgen B and C channels are 12 to 20 and 13.5 to 28.7, respectively (Rosgen, 1996). All surveyed streams in the analysis area, except Eagle Creek, are within the normal range for width-to-depth ratios for their respective Rosgen channel types (Table 5). Eagle Creek has a mix of Rosgen C and B channel types which may partially explain the higher than normal width-to-depth ratio. The width-to-depth ratio for the 2016 Eagle Creek survey is much higher than the normal range; 50.6 compared to 20 for Rosgen B channels and 28.7 for Rosgen C channels. The June 2010 flood event took out some of the road template on Forest Road 77 and likely scoured out the banks and widened the channel in places which may have increased the width-to-depth ratio.

Pool habitat is lacking in the project area. LWD levels generally meet the RMO. In general, pool habitat increases as LWD increases (Dollof and Warren, 2003). However, there does not appear to be a relationship between LWD and pool habitat in steeper streams (Montgomery et al. 1995) or in streams with low stream power (Jackson and Sturm, 2002). As noted earlier the majority of streams in the analysis area are high gradient streams, including the fish-bearing which have been surveyed (Aquatic Habitat Section, Table 5), and may reduce the pool forming function of LWD in the analysis area.

Based on observations made during the 2015 and 2017 stream evaluations, streams in the project area indicated that stream stability was generally high and met the 80% stability standard (Aquatic Habitat Section, Table 5). Many of the streams are located in inner gorges, and have rocky well-vegetated banks; typical of Rosgen B-type channels.

All action alternatives avoid adverse impacts to riparian and aquatic habitats by designing the project to be consistent with Forest Plan Standards and Guidelines for aquatic habitat. Effects (direct, indirect, and cumulative) of proposed activities on habitat for redband trout are disclosed in the Aquatic Habitat section of this report. Effects (direct, indirect, and cumulative) to redband trout resulting from the Two Eagle Project are disclosed in the Aquatics Biological Evaluation Report.

In summary, under Alternative 2, 2m and 3, increases in fine sediment in aquatic habitat would likely occur as a result of culvert installation, removal, and replacement activities (5 sites). In addition, a very small amount of road reconstruction within RHCAs, could contribute sediment into channels that would have a short term effect on water quality and fish habitat by increasing sediment input into channels. The predicted increases, however, are likely to be short term and to not extend beyond 0.125 miles downstream the road stream crossing.

A decrease in erosion from road surfaces will occur as a result of the proposed road improvements. This decrease in erosion rates will likely result in a mid to long-term decrease in fine sediment in Eagle Creek, Jim Creek and Grove Creek in the analysis area. The proposed action will also improve vegetative conditions and maintain the natural fire regime in the long-term in the project area. Both of these long-term outcomes will have beneficial impacts to redband trout and their habitat in the analysis area. Decommissioning 11.06 miles of road in Alternative 2, 2m, and 3 including 2.65 miles in Category 1 RHCAs, would additionally reduce erosion from road surfaces in the project area in to streams containing redband trout.

The level of effects anticipated to result from the Two Eagle Project will maintain or have minor long term improvement on habitat conditions for redband trout in the project area. Anthropogenic fine sediment delivery in the project area will be decreased when road maintenance activities are complete. In the long-term, there would be a reduction in artificially induced sediment entering the stream systems, benefiting aquatic MIS and their habitat. The project is not expected to contribute to a negative trend in viability on the Wallowa-Whitman National Forest for redband trout.

Consistency with Direction, Regulations, and Laws

Wallowa-Whitman Forest Plan

The Two Eagle Project is consistent with the WWNF Forest Plan including the 1995 INFISH amendment. In addition to meeting standards and guidelines for water quality (see effects to aquatic habitat discussion), the proposed activities are consistent with all Forest Plan Watershed, and INFISH standards and guidelines.

Watershed Standards and Guidelines

1. Conflicts With Other Uses. Give management and enhancement of water quality, protection of watercourses and streamside management units, and fish habitat priority over uses described or implied in all other management standards or guidelines. ***Met through application of BMPs, mitigation measures including project design features (PDFs) and INFISH RMOs.***
2. Water Quality Standards and BMP's Meet Water Quality Standards for waters of the States of Oregon (Oregon Administrative Rules, Chapter 340-41) and Idaho through planning, application, and monitoring of Best Management Practices (BMP's) in conformance with the Clean Water Act, regulations, and federal guidance issued thereto. ***Water quality standards are not met in Eagle Creek for biological criteria, Eagle Creek is listed for bacterial pollutant E. coli***. ***BMPs and mitigation measures including project design features (PDFs) will be applied to project activities to address INFISH RMOs.***
3. Use the following process in cooperation with the States of Oregon and Idaho
    a. Select and design BMP's based on site-specific conditions, technical, economic, and institutional feasibility, and the water quality standards for those waters potentially impacted (See Watershed Management Practices Guide for Achieving Soil and Water Objectives, Wallowa-Whitman NF).
    b. Implement and enforce BMP's
    c. Monitor to ensure that practices are correctly applied as designed.
    d. Monitor to determine the effectiveness of practices in meeting design expectations and in attaining water quality standards.
    e. Evaluate monitoring results and mitigate where necessary to minimize impacts from activities where BMP's do not perform as expected.
    f. Adjust BMP design standards and application when it is found that beneficial uses are not being protected and water quality standards are not being achieved to the desired level. Evaluate the appropriateness of water quality criteria for reasonably assuring protection of beneficial uses. Where appropriate, consider recommending adjustment of water quality standards.

    Met through BMP development during project design and analysis. Implementation and monitoring of BMPs will occur when project implementation proceeds.
4. State Water Quality Management Plans. Implement (Oregon) State Water Quality Management. Plans on lands administered by the USDA Forest Service as described in Memoranda of Understanding between The Oregon Department of Environmental Quality and US Department of Agriculture, Forest Service (2/12/79 and 12/7/82), and "Attachments A and 8" referred to in this MOU (Implementation Plan for Water Quality Planning on National Forest lands in the Pacific Northwest 12/78 and Best Management Practices for Range and Grazing Activities on

Federal Lands, respectively). ***Beyond the scope of this project. A Water Quality Restoration Plan will be developed after the TMDL is completed for the Powder River Basin.***

5. Mitigation. Mitigate negative impacts causing reduction in water quality to return water quality to previous levels in as short a time as possible (It is recognized that short-term reductions in water quality may result from some activities. For example, turbidity may increase for several days following bridge or culvert installation). ***BMPs and PDFs have been designed as effective mitigation for the project.***

6. Timber Management. Harvest will not occur, on a scheduled basis, within 200 feet or 100 feet of the high water line on either side of Category 1 and 2 streams. ***The EA shows how timber harvest will not occur within RHCAs, with limited exceptions. The maintenance of water quality and riparian habitat is shown in the EA.***

7. Stream Temperatures. Prevent measurable temperature increases in Category 1 Streams (less than a 0.5 degree Fahrenheit change). Temperature increases on SMU Category 2 (and fishbearing SMU Class Ill) streams will be limited to the criteria in State standards. Temperatures on other streams may be increased only to the extent that water quality goals on downstream, fish-bearing streams will still be met. Normally stream shade management on Class III streams will differ little from treatment on Class II streams. ***No increases in stream temperatures as shown in the EA.***

8. Channel Stability. Maintain natural large woody debris, plus trees needed for a future supply, to protect or enhance stream channel and bank structure, enhance water quality, and provide structural fish habitat within all SMU classes. Quantities and sizes will be determined on a case-by-case basis***. No change in channel stability or LWD supplies as shown in EA.***

9. Enhance streambank vegetation and/or large woody debris where it can be effective in improving channel stability or fish habitat. ***No change in streambank vegetation or LWD as shown in the EA.***

10. Give areas in which water quality or channel stability are being adversely impacted high priority for treatment to minimize the effects of the impact or to correct the impacting activity. ***No adverse impacts to water quality or channel stability as shown in the EA.***

11. Conduct Cumulative Effects Analyses. When project scoping identifies an issue or concern regarding the cumulative effects of activities on water quality, stream channels, or fish habitat a cumulative effects assessment of these effects will be made. This will include land in all ownerships in the watershed Activities on National Forest System lands in these watersheds should be dispersed in time and space to the extent practicable, and at least to the extent necessary to meet management requirements. On intermingled ownerships, coordinate scheduling efforts to the extent practicable. ***No concerns regarding cumulative effects on water quality, stream channels or fish habitat were identified during scoping. A cumulative effects analysis was done in the EA and Appendix D.***

12. Alter watershed conditions only to the extent that aquatic and riparian goals will still be met and other valid water uses, such as irrigation, will not be adversely affected. When planned projects are likely to adversely affect watershed conditions, a hydrologic analysis will be conducted considering past, present, and future activities. If the results of this analysis indicate that the proposed project would adversely affect watershed condition, the project will be altered. This may include such things as deleting or rearranging harvest units in timber sales, selecting different prescriptions, or delaying activities for one or more decades. ***No alterations of watershed conditions are expected.***

13. Groundwater: All projects or activities (including but not limited to pesticide application, fertilizer application, or storage of potentially hazardous volumes of fuels and other chemicals on National Forest System land) with the potential to adversely affect surface or ground waters, will include constraints and/or mitigation measures designed to prevent contamination, and will include a plan for dealing with accidental spills. ***No effects to groundwater are expected.***

14. Floodplains: Address in all project environmental analyses the presence of, and potential impacts, to any floodplain within the project area. ***No impacts to floodplains are expected.***

15. Invest in major structures, roads, or other facilities within floodplains only if no feasible alternative site outside the floodplain exists. ***No investments within floodplains will occur.***

16. Permit short-term adverse impacts on floodplains only in conjunction with specific mitigation measures designed to minimize the impacts. Where activities adversely affect natural floodplains, the floodplains will be restored, to the extent practicable, shortly after the activity has ceased. ***No adverse impacts on floodplains will occur.***

17. Wetlands: Address in all project environmental analyses the presence of, and potential impacts to, any wetlands within the project area. Particular attention will be paid to protection of springs during road location, timber sale plans, and range allotment management plans. Adverse impacts to wetlands will be avoided or mitigated. ***No adverse impacts to wetlands will occur.***

18. Roads and Skid Trails. Do not construct roads through the length of riparian areas. Roads crossing riparian areas will not alter stream or ground water flow characteristics to a degree which will impact the riparian characteristics. ***No road construction through riparian areas will occur. No alteration of stream or groundwater will occur. No impact of riparian characteristics will occur.***

19. Design and maintain road drainage to prevent the influx of significant amounts of road sediment runoff into streamcourses. ***Road drainage design has been done to reduce sediment delivery to streams.***

20. Manage roads currently located in riparian areas or streamside management units to minimize impacts to water quality and wildlife habitat. In some instances, this will require higher levels of maintenance, road surfacing, or drainage than would normally be justified on the basis of road use alone. Roads may be closed, obliterated, and rehabilitated when it is determined, through an environmental analysis considering all resources, to be the best alternative. ***Road management has been designed to minimize impacts to water quality and wildlife habitat. Decommission 11.06 miles of roads has been included for all action alternatives.***

21. Locate skid trails and roads to avoid paralleling stream channels in streamside management units. Log landings will not be placed in riparian areas. Skidding logs down streamcourses or ephemeral draws will not occur. ***No skid trails within RHCAs. Only existing roads will be used. Log landings are outside of riparian areas. No mechanical entry in to RHCAs..***

22. Avoid the use of heavy equipment (such as crawler tractors and skidders) within riparian ecosystems. When such use is unavoidable (as in the construction of bridges or other stream crossing devices or during the construction of stream channel improvements) the activity will include mitigation measures designed to minimize adverse effects on the riparian zone and downstream values. Ground disturbing activities will normally be limited to 10 percent exposed soil or less within riparian ecosystems. ***No mechanical entry into RHCAs. The construction of stream crossings (culverts) necessary for hauling logs will include all appropriate BMPs.***

23. Manage recreation activities to prevent site deterioration within riparian areas. Trails will be designed and maintained to minimize riparian impacts. ***No recreation activities are planned.***

24. Fuel Treatment. Remove slash created as the result of an activity within the normal high water zone of Class I and II streams unless needed for soil protection or other purposes. Slash removal from other streams may be required where resource damage would otherwise result. Slash piles normally will not be located within riparian areas. ***No slash will be created within the normal high water zone of Class I and II streams (Category 1).***

INFISH Standards and Guidelines

- INFISH TM-1: Mechanical thinning activities will occur in RHCAs to meet silvicultural objectives for stands. Thinning will not occur within 100 feet of Category 1, 75 feet of Category 2 or 50 feet of Category 4 streams.
- INFISH RF-2a: No new system roads to access logging units are proposed. Temporary roads will be decommissioned following completion of timber haul activities.
- INFISH RF-2b: No mechanical entry in RHCAs, no landings will be constructed in RHCAs in the Two Eagle project area.
- INFISH RF-3a & b: Roads that will be used for proposed vegetation management activities will have drainage problems repaired and will be brought up to standards prior to haul.
- INFISH FM-1: Proposed activities (noncommercial and commercial thinning, prescribed burning) would not retard the attainment of Forest Plan RMOs for aquatic habitat (pool frequency, water temperature, LWD, bank stability, lower bank angle, and width-to-depth ratio). Proposed burning activities may result in short-term increases in fine sediment and decreases in shading in RHCAs adjacent to streams in the aquatic effects areas. However, the magnitudes in the increases in fine sediment or reduction of shading are unlikely to result in measurable changes in fine sediment levels or water temperatures in the aquatics effects area.

Eagle Creek Wild and Scenic River Management Plan

Fisheries and water quality have been designated as Outstanding Remarkable Values (ORVs). Management direction applicable to the Two Eagle Project regarding the Fisheries ORV is presented in Table 18.

Table 18. Standard and Guidelines Applicable to the Fisheries ORV for the Eagle Creek Wild and Scenic River Plan

Standard and Guideline	Description	Consistency check with S&G, including rationale
4	Protection and enhancement of ORVs	Yes. Long-term reduction in sediment from roads.
31	Utilize current and additional direction for maintaining and improving water quality (water quality at the time of river designation or closest estimate) as it relates to fish habitat, including but not limited to sediment, stream temperature, shading, and large woody debris.	Yes, the Two Eagle Project incorporates Forest Plan Standards and Guides, INFISH Standards and Guidelines and project specific design features and best management practices to limit short-term impacts to water quality. Long-term improvement of water quality is anticipated due to a reduction road related erosion and sedimentation.
32.	Maintain and improve water quality.	Yes. Long-term reduction in road related sediment and erosion.
33.	Maintain stream flows.	Yes. No change in water uses planned with this project.
34.	Manage dispersed recreation to reduce sediment.	Yes. This project does not make a decision on managing dispersed recreation.
38	Manage for high levels of LWD in the channel.	Yes, the Two Eagle Project avoids impacts to LWD by implementing INFISH RHCAs and

Standard and Guideline	Description	Consistency check with S&G, including rationale
		limiting thinning activities to 8 acres outside the zone of influence for LWD. And 27 acres of limited conifer thinning for mule deer habitat enhancement in Alt 2m.
47.	Protection of watersheds.	Yes. Protection of watersheds is met through project design features and BMPs.
48.	No measureable reduction in water quality.	Yes. Long-term reduction in sediment from road reconstruction and decommissioing.
51.	Maintain existing interim buffers.	Yes. Interim RHCA buffers will be used.
54.	Do a Water Development Analysis if any impacts to Eagle Creek.	Yes. Because no measureable impacts are expected, no WDA will be done.
56.	Improve roads to reduce sediment.	Yes. Long-term reduction in sediment from roads, reconstruction, decommissioing.
96.	Correct sediment problems on roads 77, 7735, 7750-025, and 7755.	Yes. Road improvements scheduled for 77 road.
106.	Address any potential effects to the river corridor and ORVs.	Yes. The EA examines all potential effects.

The Two Eagle Project is consistent with the Eagle Creek Wild and Scenic River Management Plan. No mechanical thinning activities in RHCAs would occur. Thinning would not occur within 100 feet of Category 1 streams, and no thinning would occur within RHCAs of Category 2 or Category 4 streams. No impacts to shading or future LWD levels would occur as a result of the proposed thinning adjacent to Category 1 streams because minimum buffers on channels would exceed one site potential tree height. No increases in fine sediment would occur; no mechanical entry into RHCAs would occur.

Measurable increases in fine sediment are predicted as a result of the replacement two culverts on fish bearing Jim Creek and Grove Creek, removal of a culvert on upper Jim Creek and installation and removal of two temporary culverts on Jim Creek and a tributary to West Eagle Creek. These increases are predicted to be short-term. Aquatic habitat downstream is expected to have a short term sediment pulse delivered up to 0.125 miles downstream of road stream crossing activities. Under Alternative 2, 2m, and 3 five sites could have short term increases in fine sediment. These activities would directly impact water quality (if water is flowing in streams when culver removal and installation occurs), which could indirectly effect downstream fish and aquatic habitat. Increases in turbidity and fine sediment are expected to return to preconstruction levels within 48 hours.

Endangered Species Act

A separate abbreviated Biological Assessment using the Blue Mountain Project Design Criteria for Blue Mountain Expedited Section 7 ESA consultation process for Bull Trout Designated Critical Habitat was prepared and submitted to USFWS for Two Eagle Vegetation Management and their concurrence was based on the preferred alternative. This ESA consultation was completed on August 23, 2018. The USFWS Letter of Concurrence (USFWS reference O1EOFWOO-2013-I-0173) for the project concludes that the proposed activities may affect, but are not likely to adversely affect designated critical habitat for bull trout. The Letter of Concurrence will be part of the administrative record.

Clean Water Act

Consistency with the CWA and State Water Quality Law for the No Action Alternative

River mile 0-21.1 of Eagle Creek is listed on the 2010 ODEQ 303(d) list for elevated levels of *E. coli* in the project area. This is a category 5 listing and a Total Maximum Daily Load (TMDL) for the Powder Basin has been initiated. Some existing road segments do not meet standards set forth with Forest BMPs

reduce sediment delivery to the extent practicable. Assumptions made for the no action alternative include continuation of existing road management practices where full implementation of BMPs are lacking and therefore sediment delivery is not reduced to the extent practicable. Consistency lacks with LRMP Watershed Standards and Guides 2, 3, and 19 for the same reason (lack of implementing BMPs on existing roads). Consistency with all other LRMP Standards and Guides and Executive Orders 11988 and 11990 is met because no actions will be taken.

Consistency with the CWA and State Water Quality law for all Action Alternatives

Eagle Creek is listed on the 2010 ODEQ 303(d) list for elevated levels of *E. coli* in the project area. A TMDL has been initiated for the Powder Basin and upon completion the Wallowa-Whitman National Forest will create a Water Quality Management Plan (WQMP) for all US Forest Service lands within the basin. Eagle Creek flows downstream through many miles of private, agricultural land before reaching the LASAR (Laboratory Analytical Storage and Retrieval) station, downstream of the town of Richland, Oregon. Consistency will be met through implementation of BMPs, considered as a performance standard for control of non-point source water pollution. Active grazing and recreational residences within the boundary of the project area could be a source of this bacteria but a 2016 stream survey on Eagle Creek did not indicate that grazing was an issue (i.e. unstable banks). Recreational residences lie within the project boundary but the private property is excluded from the project and was not stream surveyed either so impacts from them were not examined. Because the project includes actions to reduce long-term sediment delivery from roads, it meets compliance required by CWA and the State of Oregon. This project complies with the Wallowa-Whitman National Forest Plan as amended by INFISH, by not impeding attainment or progress of objectives for habitat conditions within RHCAs and supporting all other applicable LRMP standards and guidelines listed in the Regulatory Framework.

Floodplains and Wetlands

The proposed action alternatives would have no impact on floodplains or wetlands as described in Executive Orders 11988 and 11990. Floodplains and wetlands will be protected by applicable INFISH RHCA buffers.

Recreational Fisheries

The Two Eagle Project will not result in reductions in quantity, function, sustainable productivity, and distribution of recreational fisheries as directed under Executive Order 12962, Recreational Fisheries.

Irreversible/Irretrievable Effects

Irreversible effects are not expected. Reduced population viability for redband trout is not expected. INFISH established explicit goals and objectives for inland native fish habitat condition and function. By following INFISH standards and guidelines as well as design criteria specific for this project, it is believed that irretrievable commitment of this resource can be avoided. The goal of INFISH is to achieve a high level of habitat diversity and complexity through a combination of habitat features.

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